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INSTRUMENTATION IN THE RETORT HOUSE

A FEATURE of most of the installations of carbonising plant designed and erected in recent years is the elaboration of instrumentation. The vertical retort particularly depends for its efficiency on the maintenance of constant conditions, in the settings, in the retorts themselves (especially in the continuous retort), in the producers, in the gasways from the retorts, and to and from the waste heat boiler. The refractories of the retorts and settings are now so highly developed and are so continually operated to the limits of safety that a constant watch on temperatures and pressures within the retorts and the surrounding combustion chambers is a vital necessity. Mr. Ernest West is discussing the details and arrangement of the equipment for securing this vital technical control of carbonising operations in the latest instalment of the series of articles which are appearing in *West's Gas*, the house journal of West's Gas Improvement Company. Naturally these articles relate particularly to the Glover-West vertical retort plants, but many of his principles are of general application.

In nearly every variety of industrial technical apparatus it is recognised that effective control and the maintenance of operational efficiency can only be fully realised if it is fully equipped with indicating and/or recording instruments installed at all strategic points in the system so that the operating staff are in possession of the fullest possible information as to the conditions prevailing within and about the several items of the plant. In some points, however, it is impracticable to insert permanent or stationary indicating elements; the instrument must be applied by hand and removed as soon as possible, or the observations must be made at a distance. Such points are the combustion chambers of the retort setting. Temperatures can be observed by the optical pyrometer; they are too high for the most refractory of thermo-couples. Here the very portable but not very precise 'Lunette' has given place to several modern types. All of them require skill and practice in their use and the observer is advised to check his observations against those of another skilled operator so that the 'personal equation' may be as far as possible eliminated. The disappearing filament type of instrument carries a standard lamp which necessitates a regular checking of the instrument against a standard. The pyrometer which relies on the focussing of heat rays on a thermo-couple with electrical readings is more reliable but generally not as portable.

PRESSURE CONDITIONS

THE control of pressure conditions within the setting is no less important. Mr. West makes the significant point that a change in pressure conditions may give rise to abnormal and dangerous temperature conditions only after a considerable delay. 'Regular and systematic employment of the draught gauge will give an early warning of any change in conditions.' This calls for a readily portable instrument, light in weight and of robust construction. The pressures to be measured are very small —no more than a very few tenths of an inch water gauge above or below zero. No doubt the most accurate measuring appliance for this duty is the inclined water gauge. But this gauge needs to be set up on a level bed while observations are made. The West-Kent portable gauge, while less accurate in absolute measurement, is sufficiently so in relative indication. It is an interesting development of the crude-looking 'Evertrusty' gauge which was an item in the equipment of the retort house controller of 50 years ago. Made in aluminium and fitted with a wooden handle it is easily applied by one hand to the sight hole into which a suitable tube screwed into the back of the instrument is inserted. With the precautions outlined in the article its use is entirely safe and satisfactory.

Of the semi-portable instruments the thermo-couple for temperature measurements and the Orsat gas analysis apparatus are mentioned. Cases where the thermo-couple must be removed after use are those where temperatures may be so high as to endanger the best heat-resisting metals and where it is required for temporary purposes only. Among the former examples are observations of the temperature of the gas leaving the producer and at the base of the producer gas uptake. The observations

give a valuable control of the operation of the producer and provide a rapid means of detecting air infiltration. Of the latter are observations of the rate of rise of temperature in the refractory materials of a setting on heating up—in which it is so necessary to avoid alternations up and down at the critical temperatures. The well-known and widely used Orsat is invaluable for rapid checks of the composition of products of combustion at various points of the setting and particularly at the outlet. Where a stationary instrument can be used it takes the form of the CO_2 and CO recorder The term 'instrumentation' is more generally applied, however, to those stationary instruments which may be assembled in groups on panels more or less adjacent to the sections of plant whose conditions of temperature and pressure they indicate or record. There is a tendency in modern designs to overdo the centralisation and complication of these panels. 'The temptation to centralise instruments as much as possible thereby producing an impressive, so-called, control panel of good appearance should generally speaking be resisted.' And resisted for two main reasons. One, because the instrument can never wholly take the place of personal, visual, knowledgeable inspection. The instrument should, so to speak, be placed where the operator can simultaneously have his eye on the indicator and his hand on the control. And the other because of the risks of error and time-lag when the instrument is connected with the job through a long communicating pipe. Where such pipes are unavoidable the material of which they are made and the facilities for keeping them free of obstructions require the most careful consideration.

A WARNING

A FINAL warning should be engraved on every administrative heart. Over-elaboration, over-centralisation, over-complication, instrumentation merely for the sake of instrumentation, should be avoided. Instruments should never relieve the operator of personal visitation of every accessible part of the plant. The significance and use of any instrument should be clearly understood by all concerned and if they are not all kept in good condition, clean and properly maintained, they are worse than useless. And they are worse than useless, too, unless their records and indications are regularly considered and acted upon by the responsible technical staff, forming an essential part of a properly organised scheme of plant control.

There is one type of instrument which is not referred to in this important and useful article; indeed it does not properly come under the definition. We mean the weighing machine. We confess to astonishment that in all the very proper elaboration of the modern retort house which is now in active evolution there is still so seldom any adequate provision of means of knowing with any precision what each retort bench, or even each retort house, is actually doing. We are lagging behind many other fuel users in this respect. Every modern power house is provided with a coal weigher to each boiler. We know that the modern retort house is generally provided with a coke weigher on the producer feed line, though not yet to each producer. Surely it is time that coal should be weighed and recorded to each retort house, if it is not practicable to weigh it to each carbonising unit. The crude methods at present used to estimate the coal carbonised per day in our retort houses are grotesquely out-of-date. The measurement of gas output is more difficult. At least one reputable firm of instrument makers is putting forward an instrument to measure crude gas. We need information whether this measurement is sufficiently accurate to give a reliable indication of the output from the retort house.

A LIBERAL OUTLOOK

THE controversial topic of technology in the universities was again raised this month when Air Chief Marshal Sir Roderic Hill, Rector of the Imperial College of Science and Technology, responded to the toast of 'The Guests,' proposed by Sir John Anderson, at the annual luncheon of the Parliamentary and Scientific Committee. Sir John had said that the vital question of technical education, still under discussion with that of the need to establish institutions to teach technology up to the highest level of a university honours degree, was now in the hands of the National Advisory Council for Education in Commerce. The problem, Sir John believed, was to raise the status and prestige of technology without attempting to exclude universities or other institutions, which should not be inhibited from making such contributions as they might feel able to make.

Sir Roderic Hill, in reply, said that technology had been 'brought forth as a child of science, and it was regarded with rather mixed feelings, varying from serious misgivings to almost messianic optimism.' The balancing of the aspirations of the technological colleges with the needs of the State could only be reached after a critical review of the relevant circumstances. Reverting to the role of the universities in technological education, he said that one consideration to be borne in mind was the lure of university degrees. A university education, he continued, as good as any boy or girl could profit by, was also the best thing for the nation, but the question of what a university first degree course was to consist was a matter for discussion, and it appeared more difficult to decide the contents of the scientific course than the arts course.

Sir Roderic then expressed an opinion which seems to have been directed against those who have called of late for the isolation of technology from existing universities—a matter to which we have twice referred in these pages in recent weeks. The overriding problem, he said, in the 20th century was to advance science and technology—which, if rightly studied, apart from practical value, formed an intellectual discipline and contribution to a liberal outlook—and raise the level of philosophic understanding so that they would be able to use them wisely. Their main hope was 'in the creation of an atmosphere in which human thought could flourish and prosper,' and in general he thought that this could best be accomplished with the aid of universities with a large and representative range of faculties. This, we feel, is a liberal and objective approach to a problem in the discussion of which there has been revealed too much prejudice and too little common sense.

DIVISIONAL NEWS

THE part which house magazines can play in fostering and sustaining fellowship and interest within the divisions and areas of the gas industry is today more than ever important. Not the least encouraging feature of the industry since nationalisation has been the continuance, and even extension.

of such publications, as witnessed by their steady flow into our offices month by month. We have already mentioned in these pages the publication of *Emgas* by the East Midlands Gas Board; hard on its heels has come *Contact* from the Eastern Board, representing, however, not the whole area but only the Watford Division. It is the privilege, all too often exercised, of those who indulge in book reviews 'to damn with faint praise;' our praises for *Contact* can only be sincere. From the conventional opening page with photographs of the division's chief officials to the small advertisements at the end, the magazine, which is printed in three colours on art paper, has a clear-cut, polished air reflecting an experienced hand behind the scenes. The Editor, Mr. G. M. Barris, and his staff are to be congratulated on a publication which, we believe, sets a high standard in both photography and the presentation of local news and events.

EXTRAVAGANCE OR NECESSITY

PLYMOUTH slot meter collectors were seen recently riding about the district in a taxi, and a complaint was duly lodged with the South Western Gas Consultative Council. On investigation it was learnt that for want of a spare part the van normally used for the purpose had been out of action for a week, and the taxi had been hired to keep pace with the considerable volume of work due to be done during that period. The consultative council at its last meeting expressed the view that local enquiries made by the complainant would have produced the same satisfactory answer, and would certainly have obviated an unnecessary waste of time. The incident serves to emphasise the fact that it was never intended that consultative councils should meddle with trivialities capable of being settled at showroom or local office level. Much more useful to consumers in general was the information afforded by the council in regard to coke supplies, standard hire purchase terms, and the use of the new mobile showroom. Quite early in the autumn consumers were urged to lay in stocks of coke while supplies were available, but the mild weather lent no encouragement, and today it is not possible to ensure a steady supply. That is not to say that there is a shortage; the fact is that, as in the old days of the district coke associations, supplies are being obtained from other areas. One of the most welcome announcements was that concerning the introduction of standard prices and conditions of sale, including hire-purchase, for the many types of appliances available to consumers. A consumer having alleged that a different price was charged for a cooker in one area from that in another, the council indicated that at present standardisation of prices of equipment throughout the country was impracticable owing to conditions varying between one area and another. Much good is expected to accrue from the use of the new mobile showroom when it gets under way. For the present its mobility is restricted for want of a towing vehicle and it has operated only in the Bristol Sub-division; the experience gained there will be of value when other parts of the area are visited.

SENTIMENT AND EFFICIENCY

THOSE of our readers who have glanced through the index to undertakings in our new *Calendar and Directory* may have found missing many names which have always had a place in previous years. These are the smaller units, whose disappearance is, of course, the result of developing schemes for integration within the nationalised industry. Many who welcome the increased efficiency occasioned thereby may mourn at the same time the passing of these minor entities. Small as they were, they held a tradition of individual enterprise and endeavour which it would be hard to surpass, and which we hope will be sought and not found wanting within the new framework. Of such a nature was the Bridge of Weir undertaking in the Renfrewshire group of the Scottish Gas Board. Extensions to the high pressure main from Johnstone deprived it of its *raison d'être*, and its recent close-down concluded 103 years of continuous operation. Those who assisted at the birth of the Bridge of Weir Gas Company included Mr. Matthew Gemmell, the village schoolmaster, Dr. John Munro, the local doctor, and Mr. William Shanks, of Gryffe-grove mills. Their enthusiasm was fired by the example of a Kilbirnie shoemaker who had built a back garden 'gasworks,' with a beer barrel as his holder and pipes made of leather, to supply his house and workshop. The company was formed under the chairmanship of Mr. Robert Barr with an initial capital of £1,000; final figures for last year show a capital of £6,000, a make of 15 mill. cu.ft., and 600 consumers. We understand that the present Engineer and Manager, Mr. M. D. Campbell, who has been in charge of the works for the last 17 years, will be responsible for distribution and sales, thus continuing a long record of service established by the late Mr. John Woodrow who was with the former company for over 40 years.

CHEMICAL INDUSTRY PLANS

WE publish elsewhere in this issue some extracts from the report prepared by the Association of British Chemical Manufacturers at the request of the Board of Trade on the long-term plans and probable lines of development of the British chemical industry. It is a document of the greatest national importance at the present time and is quite unique in that it marks the first occasion that a comprehensive survey has been made of the industry, its history, its origins, its dispositions and activities today, and its plans for tomorrow. It aims to give a clear picture of the industry, its relations with other industries, and the place it occupies in present-day industry as a supplier at one and the same time of basic raw materials and highly finished products. The report, which has been in the hands of Mr. Harold Wilson, President of the Board of Trade, nearly six months and has only now been released after several excisions have been made for confidential reasons, is the result of ready and willing co-operation on the part of a large percentage of the members of the Association who have unreservedly pooled their information for the good of the industry as a whole. It shows that a five-year plan of rehabilitation and expansion is in progress which should increase the industry's productive capacity by some 70% by the end of 1953 and that annual expenditure on research is expected to rise from about £8½m. mill. to £11½ mill., with an additional capital expenditure of just under £8½m. Emphasis is laid in the closing chapter of the report on the adverse effect of the many Government controls and the urgent need for a rapid relaxation of those that are no longer essential. No mention is made of nationalisation, but the final paragraph of the report leaves no doubt as to the attitude of the chemical industry towards any such move. Those responsible for the report 'are convinced that in this immensely complicated industry, or series of industries, in which the threads of chemical science are woven into so many and so intricate patterns, and which is a continuous venture into the unknown, an industry which has its contacts and associates in many lands and which both at home and abroad is intimately bound up with a wide network of marketing organisations, the national purpose will best be served by the utmost freedom of enterprise, and that only thus can the plans outlined in the report bear full fruit.'

AN AUSTRALIAN PROJECT

THE President of the Australian Gas Institute, Mr. E. S. Finlason, in his address at the annual meeting of the Institute, remarked that the Governments of the States outside New South Wales in which there are coal deposits are investigating the possibility of using these coals for gasification purposes. In Victoria, Parliament recently set up an all-party committee to enquire into brown coal gasification. This Committee has completed its sittings at which expert evidence was tendered. The members of the committee have reported independently to Parliament and the Premier made the following statement: 'The suggestion which has been accepted by the Metropolitan Gas Company and others interested is that we will proceed with the Lurgi process at Melbourne but instead of installing a large three generator plant the Company will proceed to install immediately—that is as soon as the order can be fulfilled—a one generator plant capable of producing 2,500,000 cu.ft. of gas per day. We hope that the plant will be ready by the middle of 1952. . . . In the meantime the

Government intends to proceed with the setting up of a Fuel Authority at Morwell. The future development of the Lurgi gas-making process will be at Morwell.' All countries which have or are likely to have a gas supply will watch with interest this large-scale experiment in the complete gasification of coal, and will follow, too, the progress of a new Fuel Authority, under Government auspices, in Australia.

Personal

Miss **D. E. Miskin** (Swansea), a member of the Wales Gas Consultative Council, has been appointed Deputy Chairman of the council.

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Mr. **D. Brading** has succeeded Mr. G. Tosswill as Hon. Secretary of the Southampton branch of the British Gas Staff Association. His address is 19, Frenewood Crescent, Bitterne Park, Southampton.

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Mr. **V. A. Lowinger,** C.B.E., retired from the Chairmanship of the International Tin Research and Development Council, which controls the Tin Research Institute, on December 31 last, as he is no longer permanently resident in England. His successor is Mr. **G. F. A. Burgess,** a Joint Managing Director of the British Metal Corporation, Ltd.

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Mr. **Godfrey Claxton,** M.SC., and Mr. **R. A. Fraser,** B.SC., A.R.I.C., have been appointed Chief Chemist and Assistant Chief Chemist, respectively, by the National Benzole Co., Ltd. Mr. Claxton was educated at the Leeds Boys Modern School and Leeds University, where, in 1923, he gained a First Class Honours B.SC. Degree in Chemistry, being awarded the degree of M.SC. in 1924. Prior to his appointment in July, 1924, as Assistant Research Chemist to the Joint Benzole Research Committee of the University of Leeds and the National Benzole

Mr. G. Claxton

Mr. R. A. Fraser

Association, he held a University Scholarship for one year, carrying out research under Professor H. M. Dawson on the salting out of phenol. He became Research Chemist to the National Benzole Co., Ltd., in 1935. Joint author, with the late W. H. Hoffert, of *Motor Benzole—Its Production and Use*, and a frequent contributor to the technical Press, Mr. Claxton is a member of several technical committees dealing with the production and testing of benzole. He is also a member of the Standardisation of Tar Products Test Committee, and Convener of the Panel on Crude and Refined Benzole. An Associate Fellow of the Institute of Petroleum, Mr. Claxton has served on several panels of the Institute's Standardisation Committee. Mr. Fraser is an old Hampton Grammar School boy. He joined the Anglo-Persian Oil Co., Ltd. (now Anglo-Iranian), as a Junior Laboratory Assistant in 1926. After seven years at their Sunbury research station he went to A. Boake, Roberts & Co., Ltd., as a shift chemist, and entered the National Benzole Co., Ltd., as a Senior Assistant in the control department in 1935. Obtaining his B.SC. Degree in 1937, after studying at evening classes, Mr. Fraser became an A.R.I.C. in 1940. In 1947 he was promoted to Control Chemist—a post involving responsibility for the quality control of all products marketed by the Company. He has taken a special interest in lubricants.

Mr. **Alec J. Henry,** who has been Assistant Engineer at Loughborough since 1945 and was previously at Hinckley, has been appointed Manager of the Market Harborough undertaking of the East Midlands Gas Board.

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Mr. **R. G. C. Champion,** M.I.H.V.E., F.R.S.A., late General Manager of Kelco (Metals), Ltd., subsidiary of Matthew Hall and Co., Ltd., who is widely known in the heating and ventilating industry, as well as for his work in connection with infra-red equipment, has joined Cowper Penfold and Co., Ltd., and its associate company, D. J. Engineering Co., Ltd., as Commercial Manager to both companies.

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GAS INDUSTRY AUDITORS

The Minister of Fuel and Power has, under Section 50 of the Gas Act, 1948, appointed the following as Auditors to the gas industry, for the financial year ending March 31, 1950 :—

Gas Council	Price Waterhouse & Co.
Scottish Gas Board ...	Howden & Malleson.
Northern Gas Board ...	Peat, Marwick, Mitchell & Co.
North Western Gas Board	Ashworth, Mosley & Co.
North Eastern Gas Board	Blackburn, Robson, Coates & Co.
East Midlands Gas Board	Cash, Stone & Co.
West Midlands Gas Board	Howard Smith, Thompson & Co.
Wales Gas Board ...	Walter Hunter, Bartlett Thomas & Co.
Eastern Gas Board ...	Pannell, Crewdson & Hardy.
North Thames Gas Board	Price Waterhouse & Co.
South Eastern Gas Board	Deloitte, Plender, Griffiths & Co.
Southern Gas Board ...	Wood, Drew & Co.
South Western Gas Board	Tribe, Clarke & Co.

Diary

Feb. 16.—Midland Association of Gas Engineers and Managers : 'Making the Best Use of Existing Plant and Providing Extensions with Maximum Economy,' S. K. Hawthorn. Queen's Hotel, Birmingham, 2.30 p.m.

Feb. 18.—Yorkshire Junior Gas Association: Three Short Papers, F. E. Lodge, M. Williams, and R. Hodgson. Bradford.

Feb. 22.—London and Southern Junior Gas Association: Visit to North Thames Gas Board's Meter Repair Works, Pound Lane, Willesden, N.W.10, 2.15 p.m.

Feb. 25.—Western Junior Gas Association: Joint Meeting with Wales and Monmouthshire Junior Gas Association. 'Mainlaying,' R. McAfee (Bath); 'Coke Oven Practice,' J. V. Drake (Bedwas); 'Comparative Performance of Iron Oxides,' A. G. Gaston (Bath).

Feb. 25.—Scottish Junior Gas Association: Joint Meeting of Eastern and Western Districts. Morning visit to Falkirk Gasworks. Afternoon meeting. 'The Administration of the Scottish Gas Area,' Sir Andrew Clow, Chairman, Scottish Gas Board Falkirk Gas Showrooms.

Feb. 28.—Southern Association of Gas Engineers and Managers (Eastern District): 'Gas Quality and Its Effect on Appliances,' L. T. Minchin, Consultant. Gas Industry House, 2.30 p.m.

Mar. 1.—Southern Gas Consultative Council, Bournemouth, 2 p.m.

Mar. 2.—North Thames Gas Consultative Council, St. Ermins Hotel, Westminster, 2.30 p.m.

Mar. 2.—Midland Junior Gas Association : Afternoon Visit to Ledsam Street Works of Belliss & Morcom, Ltd., Birmingham.

Mar. 8.—Eastern Junior Gas Association : Competition Papers. Ipswich.

Mar. 8.—Scottish Junior Gas Association (Western District) : Afternoon Visit to J. G. Stein & Co., Ltd., Bonnybridge.

Mar. 10.—London and Southern Junior Gas Association : Short Paper Meeting. 178-180, Edgware Road, W.2.

Mar. 11.—Scottish Junior Gas Association (Joint Meeting) : Paper by J. H. Dyde, Junior Vice-President of the I.G.E., Deputy Chairman, Eastern Gas Board. Glasgow.

South Western Gas Consultative Council

Benefits of Standardisation

WHEN the South Western Gas Consultative Council met at Taunton on February 1, the Chairman, Mr. **A. W. Loveys** (Mayor of Taunton), said the area board and the gas industry as a whole viewed with concern the proposed increase of 16⅔% in railway traffic charges. If the Railway Executive were allowed to make this additional charge the cost of carriage of coal for gas in the area would go up by nearly £200,000 a year. Mr. **F. G. Underhill** said he thought they should do something in the interests of consumers. If the increase took place it would have serious repercussions throughout the country generally.

The **Chairman** said the Gas Council was represented in making the protest to the Commission that was sitting as strong as possible. There were various aspects of the matter and all had been explored by the council and the area board. 'We made our own submissions and I think the consumers' interests are being very well looked after. We put forward suggestions to overcome the difficulty. It will, of course, also apply to coke.'

The subject of most importance with which the area board had had to deal since the last meeting of the council was that of gas prices. The taking over by the board of approximately 120 undertakings, with their widely differing conditions and multifarious tariffs, had involved a considerable amount of work in trying to find a basis for a new price structure which would lessen to some extent the existing disparities. The difficulties which confronted the board, both legal and administrative, had been great and the delay in putting into operation new price schedules had been unfortunate in that badly needed additional revenue had not been available to the board. The general aims and policy of the board in relation to gas prices would take some time to put into effect and progress in that direction was likely to be by stages, some small and some substantial. The council would, in due course, be giving this subject its consideration.

Gas Pressure and Quality

Steady progress was being made in the distribution of gas throughout the area and particularly in some of those places where improvement was most needed. Of these, he instanced Colyton, Uffculme and St. Just, where some of the deficiencies in pressure had now been rectified. A number of other similar localities would soon be benefiting by the main laying now in progress or ordered. There was still a difficulty in getting the materials necessary for this type of improvement so that the speed with which the board could act was not entirely within their control.

The board was concerning itself, too, about the quality of the gas being distributed. At quite a number of places in the past there had been no defined or necessarily consistent standard of the heating power of the gas that had been sold by volume. From January 1 gas of a declared calorific value and therefore priced in strict relation to its heating value had been supplied for the first time to Saltash, Buckfastleigh, Chagford, Chudleigh, Kingsbridge, Moretonhampstead, South Brent, Camborne, Fowey, Hayle, Lostwithiel, Padstow and St. Columb, Redruth, St. Blazey, St. Just, and Wadebridge.

On April 1 consumers in the Crewkerne, South Molton, Watchet, Axminster, Salcombe, Cullompton, Honiton-Seaton and Okehampton districts would benefit similarly.

Bulk Buying

Much work had been done by the board in an attempt to standardise prices and the conditions of sale, including hire-purchase terms, for the many types of appliances available to consumers. On January 16, a schedule for common use throughout the area was put into operation and the advantages obtained by the board through ability to buy in large quantities were now shared in equal measure by consumers in remote districts with those dwelling in the larger centres.

It was too early yet to give a comprehensive report on the results accruing from the use of the mobile showroom. So far it had not been possible to make the fullest use of it as the towing unit which had been on order for some time had not yet been delivered. As soon as the towing vehicle was available, the showroom would tour the Cheltenham Sub-Division. Up to the present, its use had been restricted to the Bristol Sub-Division and the experience gained there would be of value when other parts of the area were visited.

The board had been faced with a gigantic task in the past six months in collecting and collating the information essential to the formulation of practical plans for future improvements. It had been a period of great pressure on all those connected with the organisation of the South Western Gas Board, but results were already apparent and the rate of improvement would accelerate with the easing of the supply position of gas producing plant and distribution materials.

Coke Supplies

When it was stated that coke supplies were de-rationed to uncontrolled premises, Mr. **L. P. Ingram** (Northern and Southern Divisional Deputy-General Manager) said there was a surplus of coke in the country but a great shortage in the South-Western area and they were importing large quantities from other districts. The cost of carriage did not fall on the purchasers, but was met from a levy fund and they were at present drawing more from the fund than they were putting into it. The necessity of stocking up had been brought home to the public during the past week, when they were inundated with orders and had queues at the works of all kinds of vehicles, including merchants' lorries, handcarts and perambulators.

The **Chairman** said it was realised that not all small consumers were able to stock up, but people with the space available had not all been getting in supplies.

Mr. **Ingram** said there was one glaring case. On a Saturday morning a school sent out an S.O.S. that it had not enough fuel to keep the fire in for the week-end. There was no excuse for that.

The **Chairman** said that on the advice of the Minister a letter had been sent to all M.P.'s in the area of the South Western Gas Board setting out the procedure if they wished to notify any complaints from constituents. Local authorities had also been informed.

COPPER WATER PIPES

The British Non-Ferrous Metals Research Association has for several years been studying the behaviour of copper in supply waters with particular reference to the pitting type of corrosion which occurs occasionally in certain districts, especially in cold water pipes. The number of pipes affected is small compared with the total quantity in service. Recent work has revealed the main cause of this type of corrosion in cold water pipes, and the Association has issued a statement for the guidance of manufacturers and users of housing tubes.

The statement is based on the Association's own experimental work coupled with a detailed survey of available service information; it is made with the approval of the committee advising the Association on its research on the corrosion of copper pipes in supply waters.

(1) There is no evidence to establish the superior corrosion resistance of either of the two grades of copper allowed by the British Standards for light gauge copper tubes for water, gas and sanitation (B.S. 659 : 1944) and for copper tubes to be buried underground (B.S. 1386 : 1947). The information available suggests that the two materials—phosphorus-deoxidised non-arsenical copper (B.S. 1172 : 1944) and phosphorus-deoxidised arsenical copper (B.S. 1174 : 1944)—are equally satisfactory in service provided they are both free from carbonaceous films.

(2) There is strong evidence that the pitting corrosion of copper cold water pipes sometimes experienced in certain waters is usually due to the presence of carbonaceous films which may be produced inside the tubes by some manufacturing conditions.

(3) Pitting corrosion of copper pipes does not occur in the majority of supply waters in this country, even if carbonaceous films are present.

(4) There is as yet no clear evidence concerning the effect of carbonaceous or other films, originally present, on the serviceability of copper tubes in hot water systems.

Planning in the East Midlands Area

Progress Report Presented to Consultative Council

A MEETING of the East Midlands Gas Consultative Council was held at Nottingham on February 7, under the Chairmanship of Alderman C. R. Bates, O.B.E., J.P. The major item on the agenda was a report from the Chairman of the East Midlands Gas Board, Mr. H. F. H. Jones, regarding the organisation and planning of the East Midlands area. Alderman Bates, in introducing the report, said that the board had now had the opportunity of appreciating more fully the magnitude of the task before it, both as regards organisation and in connection with the improvement of gas supplies in the East Midlands. The board had formed the opinion that rather than wait until a comprehensive report, complete with plans for development and more advanced recommendations regarding gas charges, could be prepared the council would wish to be informed of the progress made by the board from time to time. The report submitted could be regarded as advance information which was required to be supplied to the council under Section 9 (5) of the Gas Act.

The board had recently had a report prepared to show the costs of administration at the present time as compared with those before vesting date. The present position was somewhat fluid inasmuch as they were engaged in transferring administrative responsibilities from local authorities, who were acting as their agents, to their own staffs. This process would continue for some time, but at the end of last year it appeared that the savings in administration amounted gross to approximately £20,000 per annum, out of which certain expenses had to be met, but the net saving was well in excess of £10,000 per annum. It was thought that this saving would increase rather than diminish.

The conditions of supply of gas had been found to be most unsatisfactory in a considerable number of places. Improvements had to be brought about first, by careful planning, which was in progress, and secondly, by the most efficient use of the limited supplies of pipes and of labour which were available to the board. There was an overall shortage in the country at the present time of cast iron pipes, and the area of the board covered that part of the country in which there was the greatest shortage of manpower. Nevertheless, some improvements had already been effected, and instructions had been given to all concerned that the improvement of existing supplies was to receive priority over other work. The board was always glad to receive information regarding unsatisfactory supplies and would do all that was possible to bring about early improvement.

The report from the board was then submitted as follows:—

Report from the Board

It can be said that the organisation is working well. Like any other organisation it works best in those parts of the area in which the individuals are most capable and are best suited to their appointments, and is less satisfactory in certain other places. It is believed that any weaknesses are known to the board and will soon be overcome.

The Chief Accountant is preparing a standard method of costing which will, in due course, enable accurate comparisons to be made between working costs in different parts of the area. In two divisions centralised purchasing has been commenced and in others it is being planned, and a standard system of indenting for or ordering stores has been introduced.

The East Midlands Joint Industrial Council has begun to meet at regular intervals. This is the area council which, in conjunction with the National Joint Industrial Council for the Gas Industry, regulates wages and working conditions of manual workers. It is encouraging that good relationships have been established. The corresponding organisation which will regulate the rates of pay and working conditions of staff employees has not yet been set up and awaits the settlement of certain matters at national level, but in the interim many questions requiring attention have been dealt with in conjunction with the appropriate staff organisations.

Shortage of Staff

There is at present a shortage of technical and administative staff with qualifications for positions of responsibility. It is necessary to consider the future provision of trained staff, and, as a first step, a training and education officer has been appointed. It will be his duty to see that opportunity for training is provided for all young people who enter the board's employment, and to keep in touch with educational authorities so that facilities may be arranged for the training of the staff and manual workers required in the industry. It is the board's intention to ensure that anyone who wishes to improve his or her technical qualifications will receive opportunity and encouragement.

While not falling strictly within the province of the gas consultative council, the board wishes to inform the council that it has in mind the improvement of working conditions in certain works in which they are at present unsatisfactory. Progress in this matter must, of course, be gradual. While in the first instance these measures will improve the lot of the individuals working for the board, in the long run they will ensure a better standard of service for consumers.

The new prices of gas have been received not unfavourably by consumers. Questions raised by Members of Parliament or by local authorities have been answered, but in every case it has been pointed out that the gas consultative council is the correct body to deal with matters of this kind.

The renewal of public lighting contracts which will terminate during 1950 is under consideration, and instructions have been given to general managers and managers to submit new quotations to the local authorities concerned, based on the lowest price charged for gas sold to industrial consumers, combined with a sufficient charge to recover the cost of lighting, extinguishing, and maintaining the lamps in accordance with the provisions of each contract. This will ensure that the board does not recover more than a fair sum from public lighting contracts, but it will also ensure that public lighting is not being subsidised by other consumers. There has been a tendency in the past for public lamps to be supplied below cost, possibly because public lighting was considered to have some advertising value. There is not now thought to be any publicity value in public lighting and each contract is regarded as a business proposition.

Appliance Prices

New scales of appliance prices have been operating since October 1. Largely increased sales have resulted and the chief difficulties are to obtain a sufficient number of the 'popular' type of cooker and to obtain sufficient labour to enable orders for appliances to be fulfilled promptly. Both these difficulties are under active examination, and by improved methods of purchasing and better organisation of the labour force, it is hoped that they may be overcome.

Sales of cookers during October and November have averaged more than 1,200 per week and the sales of other appliances have been at the rate of more than 1,000 a week. High grade appliances are not being supplied on hire except in a few cases in which an undertaking supplied high grade appliances on hire as part of an arrangement which has not yet been terminated.

Hire of high grade appliances has been found to be unsatisfactory for two reasons. First, the rental charged is seldom sufficient to recover the cost of supplying and maintaining the appliance, and, secondly, the customer tends to become discontented at paying a rental for an appliance which never becomes his property. Hire-purchase terms are found to be more popular in most places and more satisfactory from the board's point of view.

The council will appreciate that having taken over 100 undertakings nearly 100 different practices have been found with regard to the charges made for gas meters supplied on hire, for prepayment meters, for installations which are paid for by charging an additional price for gas and for cookers and other appliances supplied on hire and hire purchase terms. As indicated, cash selling prices and hire purchase terms have been unified so far as cookers are concerned and other appliances are rapidly being brought on to a common basis for cash sales.

A wide variation is also found in the charges made for fixing appliances, laying services, and fitting gas installations into new houses. Just as the board has found that the wide variations in gas tariffs cannot be unified quickly without inflicting hardship on some consumers,

so is it a matter of considerable difficulty to introduce uniformity into the charges outlined above.

The board has appointed a committee to review existing practices and make recommendations, but it will be some time before any definite recommendations can be made to the board and the consultative council informed.

These problems, like those concerned with gas charges, will become much easier if the board can establish a surplus of revenue which can be used to lower charges where they are higher than is desirable, without necessarily having to increase substantially charges which are somewhat lower than the average. At the present time it does not appear that the board will achieve a surplus until long term economies begin to take effect, and then only if these economies are not swallowed up by increased costs. The future increase in railway charges which has been announced will, if applied in full, cost the board over £150,000 per annum, of which £120,000 is a directly increased cost arising from the haulage of coal.

At the present time it would only be possible to give concessions in those parts of the area in which charges are above the average, by increasing charges elsewhere to obtain equivalent revenue. It is felt that the council will agree that such a step should only be taken after very careful examination.

Plans for Future Development

The supply of gas in the East Midlands area is drawn to a large extent from coke ovens owned by the National Coal Board, and by other bodies. From those coke ovens which are situated at steel works only a small amount of gas is purchased, *i.e.*, Scunthorpe, Kettering (Corby) and Stocksbridge. Negotiations for an increased supply of gas from Stewarts and Lloyds at Corby have not yet reached an advanced stage, but preliminary discussions have taken place. Increased supplies of gas will be necessary to meet the requirements of the Corby new town, and the various technical aspects of the problem are under examination.

From the coke ovens situated at or near coal mines there is not usually a market for gas other than to the appropriate gas undertaking. In the area of the board practically all the surplus gas available from such coke ovens is either sold to the board or is used at the coke oven works for steam raising and power generation.

New coke ovens to be constructed by the National Coal Board or possibly by the gas board will include provision for heating by producer gas which is made from coke, and the quantity of gas available for disposal per ton of coal from coke ovens will then be equivalent to the amount produced per ton of coal in a gasworks instead of being little more than half this quantity as at present. Heating by producer gas is more expensive than heating by coal gas, but enables considerable flexibility in output to be achieved.

It seems likely that as the older coke ovens become due for reconstruction and are either replaced by new batteries or are reconstructed, considerably increased quantities of gas will be available, but until a definte programme can be agreed with the coke oven owners as to what reconstruction will take place, detailed planning for the future cannot be completed.

It is obviously necessary when preparing a plan for the future development of the area to know where and at what time additional supplies of coke oven gas will become available, and, similarly, when existing supplies will be increased or curtailed, or will cease. Discussions have been in progress with the National Coal Board, which owns the majority of the coke ovens which supply gas to the board and, under sections 8 and 51 of the Gas Act, it is necessary that the National Coal Board, the Gas Council and area gas boards should consult with each other regarding the development of facilities for the carbonisation of coal in their respective areas.

Works Extensions

It is too early to say at present which works will be closed down when sufficient gas is available from more efficient gas manufacturing stations, but it already appears that the following works situated within what may be called the coke oven gas area will be developed.

Sheffield: Grimesthorpe and Neepsend; Rotherham: Car House works; Nottingham: Basford works; Derby: Litchurch works.

Plans have also been prepared for enlargement of the works at Leicester, Northampton, Lincoln, Grimsby, and Spalding and existing works will continue to make gas for a number of years in numerous other places.

At Scunthorpe a supply of gas is taken from the Appleby-Frodingham Steel Company, but this supply is insufficient for the whole of the gas requirements of the consumers. Discussions have been taking place with the owners of the coke ovens, with a view to obtaining an increased supply, and perhaps extending the period of the existing contract, which terminates in 1957. The price asked for additional supplies was, in the opinion of the board, uneconomical and it is known that all the gas produced by the coke ovens can usefully be employed in the steel works. It has been decided, therefore, to install gas manufacturing plant at Scunthorpe of a sufficient size to bridge the gap between the requirements of the gas consumers and the quantity of coke oven gas available.

Should it not prove possible at a later date to negotiate an extension of the coke oven gas contract, it will be possible to extend the plant now being installed so as to manufacture all the gas required. It is expected that gas will be manufactured before Christmas, 1950, when existing carbonising plant at the gasworks, which requires extensive reconstruction, can be closed down.

It is hoped before the end of the current year to submit a more detailed statement, giving particulars of the development which is planned, and of trunk mains which will be required to make use of future supplies of coke oven gas and of gas manufactured in the central manufacturing stations referred to above.

In a number of places in the board's area the supply of gas from the technical point of view is not as good as it should be. In many cases this is due to the mains, laid many years ago, having become overloaded and requiring replacement or reinforcement with larger pipes. In other places the gasworks themselves are not of sufficient capacity to produce all the gas required during periods of peak load.

Instructions have been given that priority is to be afforded to the improvement of supplies where this is required. In view, however, of the limitations imposed by the availability of pipes and by the difficulty of obtaining sufficient labour, the board cannot promise that very quick results will be obtained everywhere. It can be said, however, that supplies in many places have already improved and that orders have been placed for additional mains to give improved supplies in many parts of the area.

Capital Projects

An appendix to the report gives details of capital projects of major importance in progress or authorised within the East Midlands area. Only installations costing more than £10,000 have been included in the statement, but a summary of their capital cost shows that £7,805,471 will be spent on these schemes, of which developments in the Sheffield and Rotherham Division and in the Notts. and Derby Division will take £3,777,173 and £2,301,083 respectively.

The board's plans for the Sheffield and Rotherham division envisage a total addition to the division's manufacturing capacity of 19 mill. cu.ft. per day, provided by a new carbonising plant, 10 mill. cu.ft. per day, at Grimesthorpe works, and a 9 mill. cu.ft. per day new C.W.G. plant at Neepsend works. The Grimesthorpe extension is due for completion in July, 1954, at a cost of £1,450,000, and that at Neepsend in March, 1951. The divisional storage capacity is to be increased by 22 mill. cu.ft. with the erection of new gasholders at Rotherham, Meadow Hall works, Neepsend works, Barnsley, and Worksop. It is also planned to connect the Clowne and Whitwell undertakings to the Sheffield grid.

Extensions at Derby

Extensions to the carbonising and C.W.G. plant within the Notts. and Derby division will provide a total additional capacity of 20¼ mill. cu.ft. per day. These comprise a 10 mill. cu.ft. per day carbonising plant, costing almost £1 mill. at Derby, to be completed at the end of next year, and carbonising plants at Burton-on-Trent, Nottingham, and Chesterfield, with capacities of 2 mill., 4 mill., and 1¼ mill. cu.ft. per day respectively. A 2 mill. cu.ft. gasholder is to be installed at Chesterfield.

Developments in the Leicester and Northants division include a 6 mill. cu.ft. per day carbonising plant and a 2 mill. cu.ft. per day C.W.G. plant at Leicester, a 3 mill. cu.ft. per day carbonising plant at Northampton, and a ¾ mill. cu.ft. per day C.W.G. plant at Loughborough. There is to be an installation of 10 vertical retorts, 2 mill. cu.ft. per day, at Grimsby, and a horizontal retort house, 650,000 cu.ft. per day, at Scunthorpe, where a 1 mill. cu.ft. gasholder will also be erected. A third retort house at Spalding, with 10 continuous vertical retorts, will provide 600,000 cu.ft. per day, and manufacturing capacity at Boston will be increased by 1½ mill. cu.ft. per day with a continuous vertical retort installation.

Copper Tubes and Fittings

Gas Salesmen's Circle Film

BY arrangement with the Yorkshire Copper Works, Ltd., Leeds, a film, 'In connection with Copper,' was shown at a meeting of the North Western Gas Board Salesmen's Circle in Manchester. Mr. J. W. Rodgers (N.W. Gas Board, Chairman of the Circle) presided, and following presentation of the film, Mr. **C. L. Dean,** Manchester District Manager of the firm, gave a talk and a practical demonstration in which he was assisted by his colleague Mr. F. A. Whinnerah.

Having enumerated the advantages of copper tube, Mr. Dean called attention to the various British Standard specifications governing the size and gauge of tubes and went on to describe a 'Yorkshire' fitting. This, he explained, operates on the capillary principle and contains, as an integral part, the correct amount of solder for making a perfect joint. 'It is,' said Mr. Dean, 'particularly suitable for gas pipe installations, being sealed, leak proof and, when made, stronger than the pipe itself. To make a joint, all that is necessary is to clean the ends of the tube and the bore of the fitting (with fine sandpaper or steel wool), supply a thin film of "Yorkshire" flux to each, insert the tube ends, and then heat with a blow lamp. When a complete ring of solder can be seen at the mouth of the fitting, it is allowed to cool undisturbed. Should a blob of solder appear at the mouth of the fitting, it is surplus. Capillary attraction being stronger than gravity, the requisite amount of solder is retained in the capillary space between the tube and the fitting in any position.

'With few exceptions, "Yorkshire" fittings are not made from castings, with the consequent liability of porosity and leakage, but from high quality brass pressings.'

In the course of a discussion which ensued, Mr. **Howell** (Manchester) referred to the screwing of copper pipes. In Manchester, he said, they used copper pipes which were screwed with ¼ in. I.P.S. threads. In the past, they had used pipes of ½ in. o.d. and screwed with a brass thread, but these had now become obsolete. The pipes were now 0.515 in. o.d. by 17 s.w.g., and screwed with a standard I.P.S. thread, the slightly larger outside diameter giving a full depth of thread which could not be obtained with the old size of tube.

Mr. **Dean** suggested that if light gauge tubes and 'Yorkshire' fittings were used it was not necessary to screw the tube. The only thread required was at the terminal points of the system, and suitable fittings were included in the 'Yorkshire' range. Much time in screwing the tubes could thus be saved with some saving also in the cost of materials.

Mr. **H. C. Jackson** (Stretford) asked Mr. Dean's opinion in regard to chromium plated tubing and 'Yorkshire' fittings for interior plumbing and gas-fitting work. What was the possibility of eliminating the unsightliness of the solder ring round the mouth of the fitting?

Mr. **Dean** explained that for a chromium or nickel plated pipe system it was necessary to exercise extra care in preparing the joints, but it presented no difficulty. First of all there must be a measurement of the distance the tube went into the fitting, and the plating on the tube ends must be removed with coarse emery, followed by fine sandpaper, for the exact distance the tubes entered the fitting. Care must be taken not to remove any plating outside the bore of the fitting. The joint was then made in the usual way, and any surplus solder could easily be removed since it did not adhere to the chromium plate. Any discoloration of the joint caused by the flux could also be quickly removed with a damp cloth or metal polish. A knife edge of solder only could be seen and would not be unsightly.

A question was asked as to the radius which ¼ in. copper tube should be bent by hand.

Mr. **Dean** explained that it was almost universal practice to use a Hilmor type of bending machine. The radius of the bend would, therefore, be determined by the diameter of the former. If springs were used, he suggested a radius of about 3 in., and for anything less than this a fitting should be used. Both the formers and guides of the bending machine should be free from rust, and greased. When springs were used, these should also be greased so that they could move freely in the bore of the tube, otherwise the spring was liable to be damaged when bending took place.

Mr. **A. Henshall** (Deputy Chairman of the North Western Gas Board) proposed that a vote of thanks to Mr. Dean and his colleague, Mr. Whinnerah, for the lecture and the demonstration.

The vote was seconded by Mr. **Jackson** and Mr. **Dean** responded.

Plans Have Been Approved at Dunfermline on behalf of the Scottish Gas Board for alterations to an existing coal store at Grange Road to accommodate a new carburetted water gas plant at a cost of £3,500.

Following His Meeting with Sir Stafford Cripps, Mr. Roger Falk, Director-General of British Export Trade Research Organisation, was received on February 3 at the Board of Trade by Mr. A. G. Bottomley, O.B.E., M.P., Secretary for Overseas Trade. Progressive discussions took place on fresh ways in which B.E.T.R.O. could serve the needs of British exporters, with particular emphasis on the dollar drive. Mr. Falk handed Mr. Bottomley a copy of the survey on the suitability of British packaging in the Canadian market recently commissioned from B.E.T.R.O. by the Board of Trade. It is understood that this survey will be made available to British industry in due course.

Eastern Gas Board employees at Cambridge were not slow to grasp the opportunity to check up on their inner health when the mobile radiography unit of the Eastern Anglian Regional Hospital Board visited the Newmarket Road works. Wide publicity was secured by means of works posters, films, and descriptive leaflets, with the gratifying result of an 87% response.

The First Stage of the £1 mill. scheme for the reconstruction of the Dover gas-works to enable it to supply a large area of East Kent has now been authorised by the Ministry of Fuel and Power and work is to begin soon. When this first stage has been completed the plant will have a gas making capacity of 5 mill. cu.ft. per day, and on the completion of the scheme this will be increased to 10 mill. cu.ft., five times the present capacity. Design and erection of the new plant is being undertaken by the Woodall Duckham Company of London.

This servicing van, one of five vehicles recently obtained for the Fife Group of the Scottish Gas Board, illustrates the attractive design and style of coachwork painting adopted by the board.

Development of the Chemical Industry

Plans for Increasing Capacity

HITHERTO unpublished facts and figures relating to almost every aspect of the chemical industry, from the labour employed and working conditions, value of capital equipment, production capacity, and export potential to methods being adopted to obtain greater productivity are contained in the Association of British Chemical Manufacturers' *Report on the Chemical Industry*, published on February 1 and obtainable only from the offices of the Association, 166, Piccadilly, London, W.1, at 5s. The report is the outcome of a request from the President of the Board of Trade for a comprehensive survey of the whole chemical industry, showing its long-term plans and probable lines of development.

The report points out that the industry employs some £231 mill. of capital, which probably represents £400 mill. in terms of today's costs. When schemes of replacement and expansion calling for the expenditure of £191 mill., to two-thirds of which the industry has already committed itself, are completed, the production capacity of the industry will be increased by 70%.

Research

In addition the industry is now spending on research £8½ mill. annually and proposes to spend £11,400,000 annually when projects for additional research facilities, involving capital expenditures of more than £8 mill. are completed. The report shows that 471 schemes of rehabilitation and expansion are in progress, 72 schemes await licences, and there are 384 schemes in the tentative stage, making a total of 927. The schemes in progress are estimated to cost £108 mill., those awaiting licences £21 mill., and the tentative schemes £60 mill.

It has been ascertained that the chemical industry employs 10,100 persons on research and development, of whom 3,000 are professionally qualified scientists. The report states that there is no evidence that in the absence of a research association for the industry there is a danger of wasteful overlapping in research. Some degree of overlap in research is, in fact, desirable. A healthy rivalry between two research teams acts as a stimulus to progress; moreover, two teams attacking the same problem from different aspects may well achieve more than either working on its own. In these ways the work of one laboratory serves to confirm and advance the work of another.

The chemical industry is estimated to employ 141,817, but the figure for the chemical and allied trades as a whole, as estimated by the Ministry of Labour, for January, 1949, is 429,600.

Increasing Production

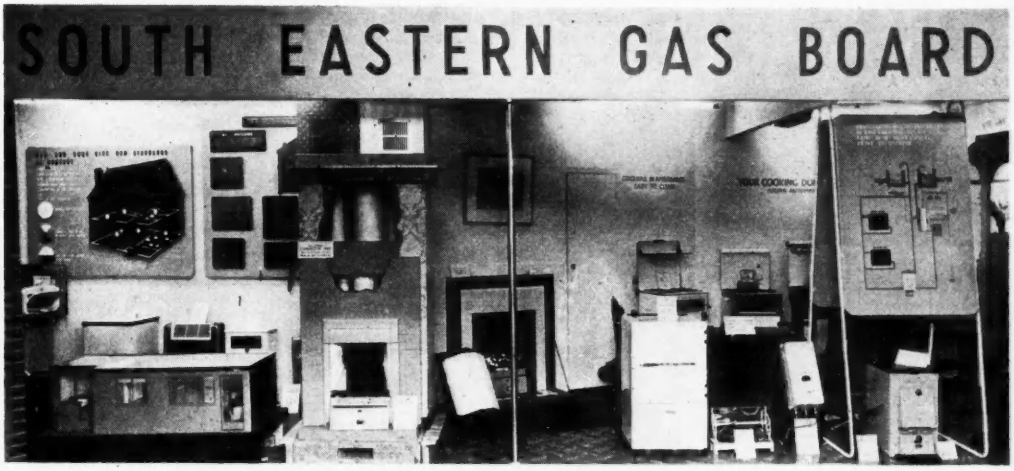
Production has been steadily increasing. Gross output by private firms in 1946 was valued at £212 mill. (or £106 mill. if converted to 1935 values) compared with a total of £65 mill. in 1935, and it is estimated that the year 1948 showed a further increase of 17% over 1946. The forward plans for the industry provide for a further increase in production capacity of 70% during the five years from the end of 1948. Making allowances for tentative schemes that may not come to fruition by 1953, there are reasonable grounds for believing that the rate of increase in production attained in 1947 and 1948 will be maintained for at least the next three years. In 1951 the output of the industry should be 50% greater than in 1946.

Dealing with the industry's plans, the report says the possibility of revolutionary changes of processes with consequent obsolescence of existing plant is ever present. Financial strength to meet such circumstances is a necessity if the industry is to maintain its position in overseas markets in the face of international competition.

Effect of Controls

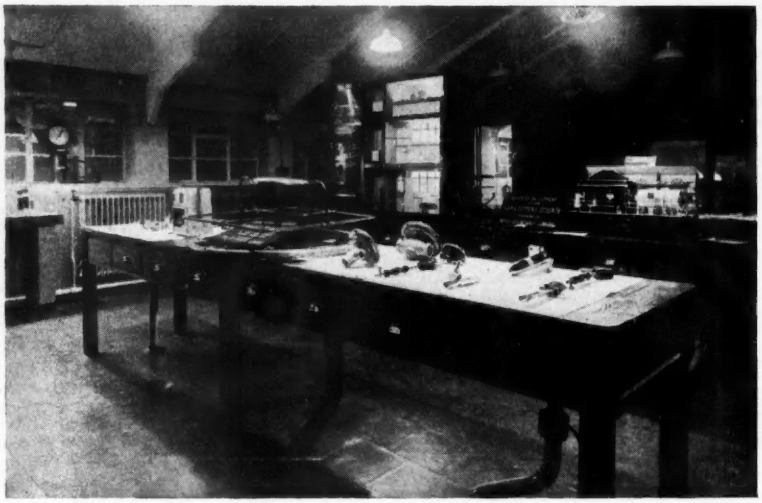
During the past decade the chemical industry, in common with many others, has felt the adverse effects of the many Government controls. While the need for control of industry by Government during the war is not questioned, the long continued extension of controls, the strict limitation of imports, and the existence of a sellers' market—fostered in some degree by bilateral trade agreements—has tended to discourage free competitive initiative, which will again be vital to success as the buyer once more exercises discrimination. These factors have affected the chemical industry as well as others, and the question is asked whether in face of competition in overseas markets, particularly from the United States and Germany, the chemical industry can in fact secure the large increase in export trade for which it plans.

The industry, says the report, must co-operate with the nationals of other lands. For this purpose there is necessary not only a rapid relaxation of the various restrictions on overseas operations suffered by the British chemical industry, but also the maintenance by the industry of methods and organisation that will make it an acceptable partner to overseas associates.



The stand of the Brighton undertaking, South Eastern Gas Board, at the 17th annual Brighton and Hove 'Home Life' Exhibition displayed a comprehensive selection of all appliances, with special emphasis on gas-ignited coke grates having back boiler and hot air ducts to the bedrooms. Great interest was shown by surveyors and builders in this latter sectional exhibit, which it is hoped will firmly establish the practice for installations of this kind already under way in the Brighton and Hove District building estates. Overhead panel heater and boiling water heater displays were closely inspected by the public. A centre of interest was the 'live' coke fire in suitable homely setting.

Swansea Technical College Extensions



Our photograph shows the exhibit arranged by the Wales Gas Board in connection with the official opening of the new extensions to the Swansea Technical College by the Right Hon. George Tomlinson, M.P., Minister of Education. Gas-fired appliances play an important part in many of the college departments. The heat engine laboratory is equipped with two independent gas-fired boilers, the larger of which supplies steam to a vertical compound steam engine of some 15 h.p. A physical chemistry laboratory provides for the study of fuel technology and gas analysis as well as for the study of physical chemistry. In this laboratory, hot water is provided by Ascot Gas Water Heaters, Ltd. The bakery department is equipped with both gas and electric ovens, and modern gas cookers naturally play an important part in the domestic science centre.

DOWN YOUR WAY

On February 5 Mr. Richard Dimbleby featured Dover in his 'Down Your Way' programme. Among the personalities interviewed was Mr. R. G. A. Clark, Manager of the Dover Group of the Kent County Division of the South Eastern Gas Board, who talked of his war experiences at Dover and about gas developments in the district. The picture shows Mr. Clark and Mr. Dimbleby (second and third from left) examining plans of the proposed new Dover gas-works.

The Sheffield Undertaking broke all previous output records, when on January 30 gas output was over 60 mill. cu.ft. for the 24 hours.

The British Industries Fair, which will be held as usual this year at Olympia and Earls Court, London, and at Castle Bromwich, Birmingham, from May 8 to 19, will attain its greatest size. For the first time, exhibitors will occupy more than 1 mill. sq. ft. of stand space, with more than 3,000 firms presenting the products of 90 industries grouped, for the convenience of trade buyers, in 32 sections. The Fair will depart this year from post-war tradition in that no single trade or industry has been selected for special emphasis.

Manpower in the Mines declined further in the week ended January 28, 900 men leaving the pits, of whom 600 were face workers. The total number employed, 707,300, is the lowest since March 29, 1947. Production of coal also fell during the week ended February 4, and the total output at 4,282,400 tons was 100,800 tons less than in the previous week. Gas available at gasworks during the week ended February 3 was 13,031.7 mill. cu.ft., against 12,704.4 mill. cu.ft. in the week before. Over the same period there was a slight increase from 1,182.5 mill. to 1,183.3 mill. units in the amount of electricity sent out for public supply.

Gas Compensation Values

The latest list of gas security values, published by the Ministry of Fuel and Power on February 3, comprises 25 stocks of 17 companies, including three South Eastern Gas Corporation debentures. In the following table securities are in units of £100 unless otherwise indicated.

Company	Compensation Value
Barrhead Ord. (£1 unit)	75/–
Do. Ord. (£1 unit, 15s. paid) ...	56/3
Brampton Ord. (£5 unit)	£6/10/–
Carnforth Ord. (£10 unit)	£19
Chertsey 3½% Red. Deb.	£100
Chipping Norton Ord. (£5 unit) ...	£1
Earby and Thornton Ord. 'A' (£10 unit)	£13 10/–
Do. Ord. 'B' (£10 unit)	£10
Do. Ord. 'C' (£10 unit)	£10
Eyemouth Ord. (£1 unit)	15/–
Inverurie Ord., before Jan. 1, 1946) (£1 unit)	25/–
Kilwinning Ord. (£1 unit)	70/–
Kirbymoorside Ord. (£1 unit) ...	20/–
Kirkby Lonsdale Ord. (£5 unit) ...	£4/10/–
Do. Ord. (£5 unit, £2 16s. 6d. paid)	£2 7/3
Lichfield Cap. 'A'	£215
Pitlochry Ord. (£1 unit)	24/–
South Eastern Gas Corporation 4% Red. Deb.	£103
Do. 3¾% Red. Deb.	£102
Do. 3½% Red. Deb.	£100
Tenby Ord. (£1 unit)	26/–
Tudhoe and Sunderland Bridge Cap. Stock 'A'	£180
Upton-on-Severn Pref. (£5 unit) ...	£2/2/6
Do. Ord. (£5 unit)	£2
Windsor 3½% Red. Deb.	£100

General view of the stand of R. and A. Main, Ltd., at the Hotel and Catering Exhibition at Olympia.

PLANT IMPROVEMENTS ON MEDIUM SIZED GASWORKS*

By H. W. MOYS, B.Sc.Eng., A.K.C., A.M.I.C.E.,
Station Engineer, Bromley Works, North Thames Gas Board

***EDITOR'S NOTE*:—Built 80 years ago by the Imperial Gas Company in opposition to Beckton, the Bromley works of the North Thames Gas Board occupies 167 acres and comprises four horizontal retort houses with a total output of 20 mill. cu. ft. per day, a water gas plant of four automatic self-clinkering 2½ mill. cu. ft. per set, and a producer gas unit of 1¼ mill. cu. ft. per day capacity. An extension of the manufacturing plant to add 7½ mill. cu. ft. per day to the total is in hand. Since 1935 modifications and replacements have been carried out in sections of the works, and the paper deals particularly with the development of recirculation of waste gas in horizontal retort settings.**

ALL the retort houses at Bromley are of identical overall size and each contains two benches of 13 settings. The distance between centres of settings is only 9 ft. 2 in. and this dimension seriously affects the design of the setting, particularly the layout of ascension pipes and producers.

Until 1934 all retorts were fitted with single ascension pipes and the gas passed through an old design of arch pipe and plug valve into the hydraulic main. The hydraulic main was continuous for either six or seven sets and acted as a foul main, the gas being taken direct from the hydraulic main to the inlet of governor. The retorts were all of moulded siliceous material 22 in. by 15 in. 'D' section and 20 ft. long, supported on silica walls on the combustion chamber side and fire brick walls on the flue side. Temperatures of the order of 1,380°-1,400° C. were worked to carbonise the charges in ten hours.

The experiments of the Fuel Research Station on the recirculation of waste gases in a horizontal retort setting by means of an external fan stimulated the interest of the staff at Bromley in the recirculation of waste gases as a means of controlling the temperature of the setting. After some experiments a patent was registered in 1934 in the name of Mr. J. A. Nichols, the assistant at Bromley in charge of the carbonising department at that time, and of the Gas Light and Coke Company, setting out the improvements in controlling temperatures in a horizontal gas retort setting. The patent rights were taken up by Gibbons Bros., Ltd., whose London Director, Mr. Metzgar, was familiar with, and took part in, the discussions on the work carried out.

The Bromley design avoided the use of any separate appliance for introducing products of combustion into the combustion zone and provided a return flue between the top regenerator flue and the combustion chamber. It was claimed that the injector action of the combustible gases issuing from the burner nozzle into the combustion chamber would be sufficient to draw back into the combustion zone some of the products of combustion: the proportion so returned was to be controlled by a damper at the outlet of the return flue in the combustion chamber.

The aims of the design installed in No. 2 retort house in 1933 were: (1) To have a high gas velocity through the nostrils of the burner type, and (2) to restrict the flow of waste gases at the inlet to the regenerators, and thus cause a slight pressure at this point.

In the place of the normal through combustion chamber there were 14 separate combustion chambers. Superimposed on the top of the nostrils in the flare bed arch was a channel 4 in. wide for a height of 10 in. and 3½ in. wide at the top for a height of 4 in. The secondary air was admitted in the lower half of this channel. The recirculated gases were admitted immediately above this burner and they flowed through a channel 6 in. deep. No dampers were provided to regulate the quantity of the waste gases flowing up this flue. At the inlet to the waste gas flues, removable baffle tiles were placed. The amount of recirculation obtained with this set was large and it was decided that dampers were required to control the quantity of waste gas recirculated.

In 1934 a complete bench of 13 settings, of the recirculator type was installed in No. 4 house. The other bench was reset with normal settings. One recirculator set had large section retorts, 24 in. by 15 in. The design of the setting was modified from that of the experimental set installed in No. 2 house in the following details: (1) The combustion chamber was of the normal type, *i.e.*, no partition walls; (2) recirculating gas dampers were installed to regulate the quantity of waste gases passing up the recirculator waste gas flue; (3) special waste gas tubes were installed at the inlet to the waste gas flue with an opening of 9 in. by 3½ in. with a baffle tile superimposed, with an opening of 8½ in. by 2 in. The settings worked satisfactorily and the behaviour of the two benches of the house gave a valuable comparison. The conditions were as follows:—

	No. 4 retort house			
	Recirculator sets		Standard sets	
Average duration of carbonising period	10 hr.	12 hr.	10 hr.	12 hr.
Average combustion chamber temperature	1,290° C.	1,230° C.	1,390° C.	1,310° C.
Inlet to regenerator	1,010° C.	950° C.	960° C.	900° C.
Average weight per charge ...	10.5	11.0	10.5	11.0

It was possible to compare the conditions of the two sections closely. The settings were first let down after 560 days at work. It was noted that the standard settings showed considerably more signs of wear than the recirculator setting. After the house had worked a further 500 days it was again let down for repairs. The difference in the condition of the two halves was very marked. The number of patching segments required on the two sections was as follows: Standard 13 sets, 2.281; recirculator 13 sets, 76.

In 1935 No. 2 house was due for resetting and it was decided to reset the house with recirculators, and in view of the satisfactory working of the large section retort in the experimental set in No. 4 to install large section retorts (24 in. by 15½ in.). The upper three rows of retorts were fitted also with double ascension pipes and hence a big improvement in the throughput of the house was made. The narrowness of the Bromley settings makes it impossible to fit ascension pipes to a greater proportion of the retorts than this.

Modifications were made in the design of the setting in view of the experience gained in No. 4 retort house. The standard waste gas flue with 9 in. by 6 in. opening was installed at the inlet to recuperator. A 16 in. by 2½ in. by 2 in. tile was placed on top of this opening. Recirculator dampers were provided

* Paper presented to the Southern Association of Gas Engineers and Managers (Eastern District), January 24, 1950.

to control the quantity of waste gases recirculated. After the settings had been working for some months the siliceous moulded retorts began to hole badly. The impracticability of the burner type nostril was then demonstrated. Pieces of retort or coke lodged in the narrow throat of the burner and it proved impossible to keep all the nostrils working. The recirculation dampers were also proving of doubtful use as slag drippings from the retorts tended to fix them in position.

In 1937 No. 3 house was reset and in view of the trouble being experienced in No. 2 house the settings were modified. Movable silica blocks were fitted to the burner and it was hoped that these could be moved in the event of any debris blocking the nostrils and that their removal would enable the nostrils to be cleared. The inlet to the waste gas flues had an opening of 9 in. by 2½ in. At this reset double pipes were fitted to the upper three rows of retorts.

Experience and reconsideration of the speed of gases through the burner ports had suggested that recirculation of the waste gases was due to the chimney effect of the column of gases in the centre of the setting being greater than that of the gases on the waste gas side. An experimental setting was therefore installed. The set is a normal horizontal retort setting with a flue for the waste gases to circulate through under the bottom retort. No dampers were fitted to these flues and the openings to the top waste gas flues were restricted to 9 in. by 2½ in. The setting worked satisfactorily and it was decided, therefore, to reset No. 1 house in 1939 with settings of this design. Modifications to the ironwork and top work were made also at this time.

The retorts installed in 1939 are of silica construction, the proportion of the retort length exposed to the gases is high, and no shields are used. The settings were built by Gibbons Bros., Ltd., who supplied 50% of the retort segments and all the remaining refractories. The other half of the retort segments were provided by the Derbyshire Firebrick Company.

The retort house was put to work in 1940 and the first half was reset last year, after a working life of 2,898 days and having carbonised 3,629 tons of coal per retort. The retorts were in good condition when pulled out. The other half of the house is due to be reset this year when it will have been in action for 3,230 days and the approximate tonnage handled by the whole house will be just over 1 mill. tons.

The total cost of all work carried out on the retorts for the whole of their working life is £6,250. This includes work in connection with the partial renewal of the siliceous clay ends, hot patching of joints, renewal of some bottom retort segments where they were badly worn by the pusher ram. This is a very satisfactory life and I am confident that the recirculation of the waste gases with its consequent reduction in maximum temperature is a major factor in the long life obtained. The following table indicates the main conditions :—

Retort size	22 in. by 16 in by 21 ft.	
Average weight per charge	14.55 cwt.	
	10 hr. charges	12 hr. charges
Combustion chamber temperature	1,330° C.	1,250° C.

The table below indicates the coke and breeze made for sale after charging all coke required for settings under slow fires for the period 1943-1948 when all the retort houses in operation were equipped with recirculator settings :—

1943	... ...	12.95 cwt./ton	1946	... ...	12.99 cwt./ton
1944	... ...	13.35 cwt./ton	1947	... ...	12.96 cwt./ton
1945	... ...	12.77 cwt./ton	1948	... ...	12.62 cwt./ton

Iron Work

All retorts until 1934 were fitted with single ascension pipes, and the distance between the centres of settings 9 ft. 2 in. only allows double ascension pipes to be fitted to three rows of retorts and single ascension pipes to the remaining two. In 1934, 1937, and 1939 retorts were reset with this arrangement of pipes. Smaller charges had to be laid in the retorts with single ascension pipes in order to avoid blockages and these charges were subjected to carbonising conditions suitable for heavier charges. Gas analysis indicated that the gas from these retorts suffered considerably more cracking with a loss of gaseous therms than from retorts at higher levels with two pipes. The ascension pipes of the single pipe retorts gave more trouble and some pitching occurred in the hydraulic main below the arch pipe of these retorts.

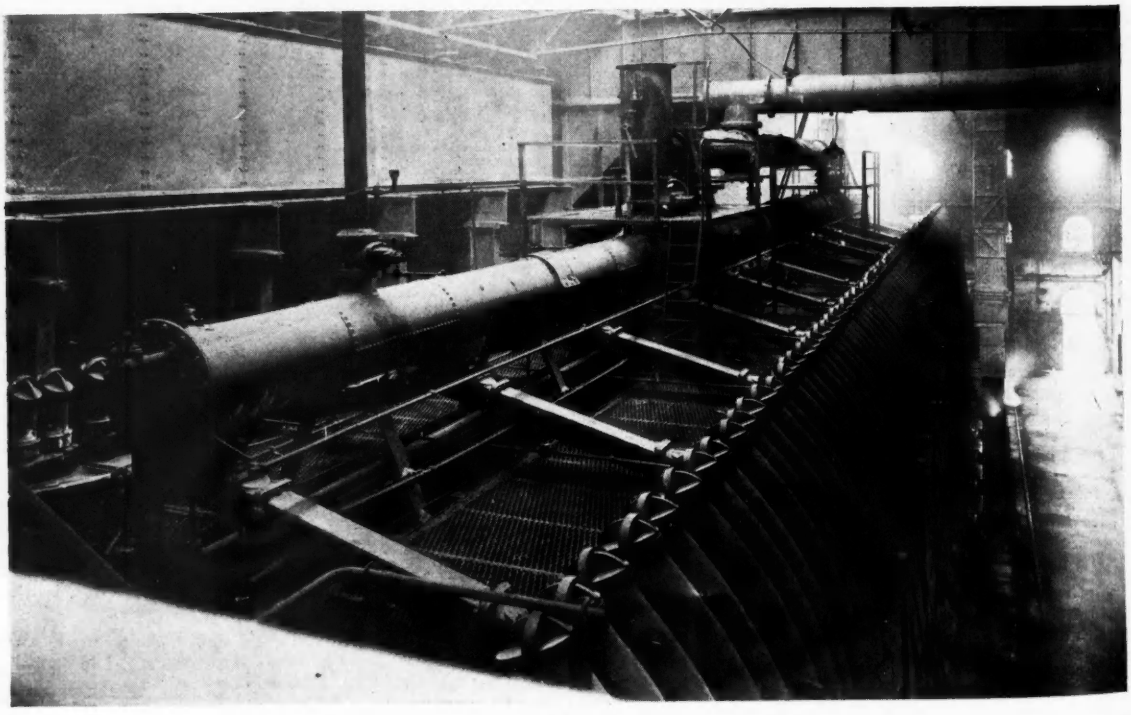


Fig. 1

To overcome this difficulty bridge pipes between the pairs of retorts in the bottom two rows were fitted so that each retort had an outlet at each end, one ascension pipe serving two retorts. The bridge pipes give little trouble, with the exception of some pitching which takes place in the pipe immediately over the producer feeder lid.

The following gas analyses each taken at ascension pipes at corresponding intervals during carbonisation (calculated to the same nitrogen content) show the improvement in the gas analysis in the retorts fitted with bridge pipes :—

	1 and 2 H retorts No bridge pipes	1 and 2 H retorts Bridge pipes	3 and 4 H retorts Double ascension pipes
CO_2	2.5	3.4	3.2
O_2	0.3	0.4	0.1
C_nH_m	3.4	4.9	4.8
H_2	58.6	52.5	52.2
CO	6.7	6.1	7.1
CH_4, &c.	24.2	28.4	28.3
N_2	4.3	4.3	4.3
H_2/hydrocarbon ...	2.12	1.58	1.58

The increased throughput which has been obtained in No. 1 retort house as a result of the alteration in retort sizes and increased offtakes is as follows :—

Setting throughput/day 10 hr. charges :	No. 1 22 in. by 15 in by 20 ft. Single pipe	No. 1 22 in. by 16 in. by 21 ft. Three rows double pipes, two rows single pipe	No. 1 22 in. by 16 in. by 21 ft. Three rows double pipes two rows single pipe and bridge pipe
Weight per charge, cwt.	10.75	14.20	15.00
Coal per day, tons ...	350	440	460

None of the houses at Bromley was fitted with foul mains and the hydraulic main was continuous for a length of six or seven settings. A small offtake leads from the hydraulic main to the inlet of governor.

Top Iron Work

When No. 1 house was reset in 1939 the top iron work was completely remodelled. It was considered that the most satisfactory arrangement of top iron work for a horizontal retort house should satisfy the following conditions :—

(1) A separate hydraulic main should be provided for each retort bed and the bottom of the main should fall transversely and longitudinally towards the tar outlet.
(2) Each hydraulic main should have a gas offtake connected to the top plate and rising to a collecting main. The gas offtake should be fitted with a valve when settings are let down as units.
(3) Liquor sprays should be fitted to each gas offtake and also to the crown of the gas collecting main to obtain the maximum amount of reflux action and deposition of light tar in the hydraulic main.
(4) The retort house governor should be connected to the gas collecting main as near as possible to the settings and at a point equidistant from the first and last settings.

The design chosen has a central foul main which is connected to individual hydraulic mains by cast iron offtakes. Liquor sprays are fitted in each offtake above the hydraulic main and in the foul main above the point where the offtakes enter. The offtakes are not fitted with valves as individual settings are rarely dropped. The individual main can be sealed off by logging.

Between the 'A' frames which carry the foul main and the hydraulic main open mesh grillage is fitted which provides a wide and spacious stage for the operators. 'BK' governors are now fitted to all retort houses. The layout of the installation is illustrated in Fig. 1.

The policy of electrifying all machinery in the retort houses has been followed steadily. Three retort houses are now equipped with electric in place of hydraulic charging and discharging machines and circulating and drainage pumps are being converted to electric drive.

The width of the producer grate with the normal arrangement of waste gas and secondary air tubes is limited to 3 ft. 6 in. owing to the distance between centres of buckstays being 9 ft. 2 in. This grate dimension makes it impossible to provide a grate area of sufficient size to supply producer gas efficiently to a setting having a high throughput when carbonising Durham run of mine coal. To enable a producer with a larger grate area to be built, the setting was designed with the recuperator tubes for the producer side of the setting constructed on the non-producer side.

Fig. 2 indicates the arrangement of these flues.

Before the war it was possible to obtain satisfactory working of the producers by cleaning twice per day, but due to the higher ash content in the coal, the producers are now ashed out three times per day. The removal of the secondary air tubes from the sides of the producer walls allows a greater time to elapse before renewing the producer linings. It is the practice at Bromley to reline the producer after 700 days' work when the average cost of labour and material to repair a producer is £30.

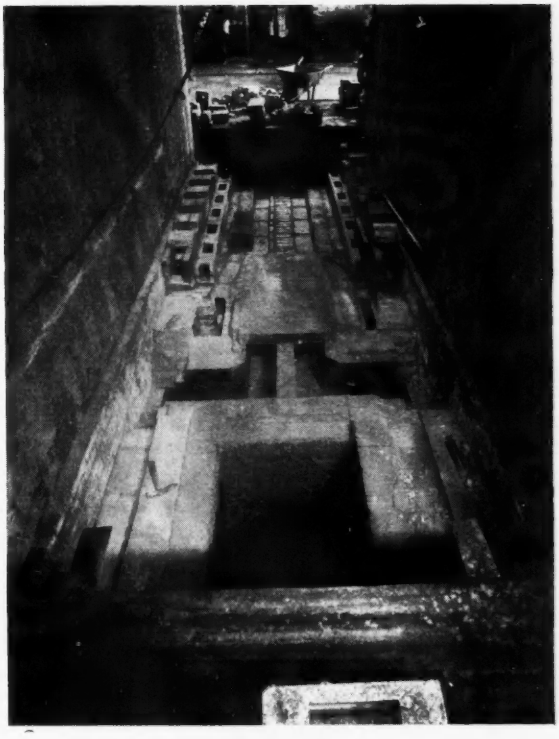


Fig. 2

In order to obtain a long working life from the settings considerable care is taken in bringing settings to their working temperature and in cooling them to atmospheric temperature when being dropped.

In the construction of the set an expansion space of ½ in. is left between the cross walls and the main pier walls. Between the main arch and the top of the division walls an expansion space to allow a vertical rise of 1¼ in. is left. A joint in each ascension pipe is left unmade with an expansion space varying from 1¼ in. for the top to ¼ in. for the bottom retorts. These expansion allowances have proved satisfactory and no distortion of the brickwork has occurred.

When raising heats care is taken not only to ensure a steady rise in temperature in the setting each day, but also to ensure that the temperature across the settings is kept uniform. A large volume of warm waste gas and air is circulated round the setting by having the producer door open and closing the producer feeder cover, combustion chamber plugs, &c. Coke is fed to the producers frequently and in small quantities. This requires labour to be in constant attention, but ensures steady temperatures.

When cooling a retort setting the cooling cannot be controlled

to any great degree. The method employed at Bromley is to empty and scurf all retorts and carry out any cleaning of the ascension pipes that may be required. The sets are then shut down by sealing up the producer feeder, clinkering doors and all plugs in the setting, and closing the setting dampers.

The settings are then allowed to cool down. Measurements have been taken of the movement of the retort mouthpieces while the setting is cooling.

Carburetted Water Gas Plant

The four carburetted water gas sets were converted from hand to automatic operation between 1925 and 1927. The sets were equipped with annular boilers and self clinkering grates. After several years of gasmaking the lower joints of the annular boilers caused considerable maintenance due to leakage. The rivet heads were eroded due to the crushing action which takes place in this zone and the area required frequent building up by welding and caulking to maintain the boilers in good condition. After a life of approximately 1,600 working days the boilers were replaced by Humphreys & Glasgow's latest type with the bottom boiler joint outside the generator and a replaceable cast steel crushing ring, built up between the boiler and the curtain plates. Steel angle rings welded on to the bottom of the boiler in place of the cast steel ring are also in use. The average life of the cast steel rings has been approximately 650 working days, but a longer life is being obtained from the welded angle rings which have so far had a life of over 1,000 working days and are still in use. It has been possible, of course, to build up wear on these rings by welding.

Care has to be taken in the operation of the set to ensure that no overheating of the crushing ring occurs. The best means of controlling hot spots in the crushing ring zone has been found to be by stopping the grate for short periods. The introduction of a water jacket to the crushing ring would appear to offer a more trouble-free ring.

The limiting pressures of the inner and outer seals of the generator grate are 32 in. and 29 in. W.G. and to avoid the risk of blowing these seals it was decided to redesign the wash box dip pipe as the pressure thrown by this vessel and the relief holder reached a maximum of 17 in. W.G. during the early part of the gasmaking run. This pressure is made up by the following factors:—

(1) The pressure thrown by the relief holder.
(2) The static head (depth of immersion of the dip plate in liquid).
(3) Expansion effect due to the change in pipe diameter.
(4) The velocity head due to the displacement of liquid below the edges of the dip pipe to allow for free flow of high velocity gas.
(5) The baffling effect of the gas moving to the wash box outlet.

Of these factors the velocity head effect is the greatest cause of back pressure, and in addition to making all flows as streamlined as possible, the best way of reducing this is to increase the perimeter of the dip pipe without increasing the depth of the seal. It is necessary also not to vary the area of the dip pipe unduly as one function of the dip is to protect the set when not gasmaking from gas flowing back from other sets in action. Back pressure from other sets might force the liquid from the seal up a very large area dip pipe breaking the seal and allowing the gas to pass back. To reduce the back pressure on the set it was decided to design a seal with an increased perimeter and able to stand against a back pressure of 26 in.

The new seal was installed in 1944 and has worked satisfactorily since. Its use has resulted in a reduction in back pressure of 3 in. to 4 in.

Producer Gas Manufacture

For periods of peak load demand an old hand operated blue water gas set has been converted for producer gas manufacture. A turbine operated Carling blower supplies the saturated blast, the exhaust steam mixing with the air, and the blast saturation temperature being adjusted by the admission of a variable supply of extra steam as desired. The blast main is sealed in a safety seal, and the producer gas passes via a normal washer seal to a wood packed washer cooler, largely made from available second-hand material. From this the gas passes into the outlet manifold of the C.W.G. plant, where it mixes with the normal make. Coke is fed by gravity to the generator, which is hand clinkered. The saturated blast temperature is adjusted to give the temperature conditions which suit both gas quality and clinker requirements. Gas production is measured by an orifice and specially calibrated inclined gauge.

Tests gave the working results of the unit as ten tons of coke and 10,000 lb. of steam per daily make of 1¼ mill. cu. ft. or about 18 lb. of coke and 8 lb. of steam per 1,000 cu. ft. (=72.8 therms per 1,000 lb. of coke).

Condensation

On the carburetted water gas stream the gas was cooled by two water tube condensers and an atmospheric condenser. The water tube condensers had insufficient capacity and it was decided to replace them. An atmospheric condenser was installed in 1943. This type of condenser was chosen as adequate ground space was available, and no cooling tower was required. The condenser consists of six parallel streams each of eight 12 in. diameter pipes, 108 ft. long.

Above the top tier of pipes horizontal wooden troughs are fitted with accurately cut 'V' notches for distributing the water. The water flow is regulated by passing through a manifold of ample size to accurately bored orifices all arranged at one level and each feeding one section of troughs. The water supply is thus divided into a large number of equal and evenly spaced streams flowing over the pipes and wetting the whole surface with a continuous film.

The following table summarises the results of a number of tests:—

	Up	Down
Direction of gas flow :		
Number of tests averaged	14	3
Gas rate, cu.ft./hr.	173,300	155,700
Water rate, gal. per hr.	4,000	3,200
Water rate, gal./ft. run hr.... ...	7	5
Gas temperature °F. :		
Inlet	176	171
After 2 rows	139	135
After 4 rows	91	99
After 6 rows	64	75
Outlet	57	63
Air temperature, °F.	55	60
Wet bulb, °F.	49	51
Water temperature, °F. :		
In	61	65
Out	73	62
Total heat dissipated, B.Th.U. per hour by 10^5	79.2	61.3

It will be noted that the gas is cooled to within a few degrees of atmospheric temperature and below that of the cooling water. The water used for cooling the gas is itself cooled by evaporation and only a small proportion of the heat is carried away by the cooling water. The water is, therefore, continuously recirculated and only a small amount of make-up water added to replace water evaporated and to keep down the salt concentration. The water at Bromley has a high salt concentration and it has been necessary specially to protect the inlet manifold from attack by salt.

The condensers for the coal gas section consisted of two Holmes' reversible tube condensers and two atmospheric condensers. All these condensers were on the outlet of exhausters. The efficiency of the plant was badly affected by naphthalene deposits and the increasing gas makes made it necessary to instal further plant.

It was decided in 1939 to install an experimental washer cooler in order to gain experience with this type of plant as the direct contact cooler offers many advantages in dealing with gas containing excessive naphthalene.

The cooler installed was rectangular in section and packed with wooden grids. The liquor passes over the grids and the gas is cooled by direct contact with the descending liquor. The hot liquor is collected in a tank under the tower and then pumped through rack coolers where it is re-cooled to its original temperature by the transfer of its heat to cooling water flowing over the racks.

The packing consisted of wooden grids made up of 4 in. parallel wooden boards, $\frac{3}{8}$ in. thick, arranged on edge with $\frac{3}{8}$ in. spaces between boards. The grids were laid in tiers at right angles to each other. The bottom edges of the boards were serrated and the grids placed so that the serrations register with the upper edges of the tier below. The liquor thus flows from board to board without splashing.

Above the boarding at the top of the tower liquor is distributed by troughs following the 'Silver' system, to ensure that the liquor was fed evenly over the whole area. To avoid the formation of solid or semi-solid deposits on the boards, the rate of liquor flow must be such that the whole of the board surface must be continuously wetted by a flowing film of liquor. The rate of liquor circulation is also such that the heat removed from the gas raises the liquor temperature sufficiently to ensure that the condensed tar retains all the naphthalene in solution and carries it away to the storage tanks.

The only trouble experienced with this cooler in nine years' working has been caused by the collapse of the lower tiers of grids. This affected the liquid flow and eventually caused excessive back pressure. The wooden grids have been replaced by metal grids and to date no further trouble has been experienced.

A washer cooler installation to deal with the whole of the coal gas make was put in hand two years ago and is now nearing completion. The installation is self-contained and has its own forced draught cooling tower.

Purifiers

The original purifiers built at Bromley by the Imperial Gas Company were all of cast iron construction with single covers sealed in water lutes. The boxes were at ground level with the mains and valves in a basement.

In 1935 a start was made to replace these purifiers as they were nearing the end of their useful life. The first two sets of purifiers erected, Nos. 3 and 4, were constructed in reinforced concrete just before the war.

Each set consists of four boxes, 40 ft. by 40 ft. by 6 ft. 6 in. deep. The floor of each box is 11 ft. 6 in. above ground and an upper storage floor is provided to enable sufficient oxide to be stored above each box for one charge. Each box contains 235 yards of oxide in two layers. Split flow is employed and the boxes are worked in backward rotation.

The box to box connections are suspended below the box floor and are provided with valves and also 'U' connections to allow of logging. It is not considered wise to rely solely on valves for gas tightness. Two gas heaters are provided for each set.

The decision to install the boxes above ground with a storage floor above them was made as it was proposed to develop eventually a central oxide handling plant and from this plant to feed the overhead storage floors by means of belt conveyors. It was appreciated that the capital cost of this design was high, but it allows rapid charging and discharging of the boxes. The oxide is discharged directly through the discharge holes into lorries for removal to the preparation yard. This work takes a 12 man gang approximately nine hours. The overhead storage floor enables the box to be charged in between three or four hours.

Fig. 3

The performance of these sets has been satisfactory and the average flow through a set is 3,250,000 cu. ft. per day.

Since the end of the war a further three sets of similar purifiers have been constructed, and a fourth is in hand. A typical arrangement is shown in Fig. 3. It will be noted that the connections have now been moved to the side of the box to allow complete freedom for the lorry traffic under the boxes. The side position of the valves also allows convenient platforms for the operators.

The oxide storage floors are covered by a roof, which keeps the oxide in good condition and also allows the work to be carried on without hindrance in bad weather.

To charge the overhead storage floors a barrow hoist is installed.

The number of charges required to be raised each year is between six and eight per set and the arrangement of the sets allows one hoist to feed two sets.

The labour cost per yard for lifting the oxide is 2s. 2.25d. and thus the overall cost for handling the material to one set is approximately £200 per annum. The lifting of one charge engages six men for three days. It is thus difficult to justify any elaborate plant to carry out this work.

It is the practice at Bromley to provide the purifying labourers with pneumatic clay diggers of non-ferrous alloys

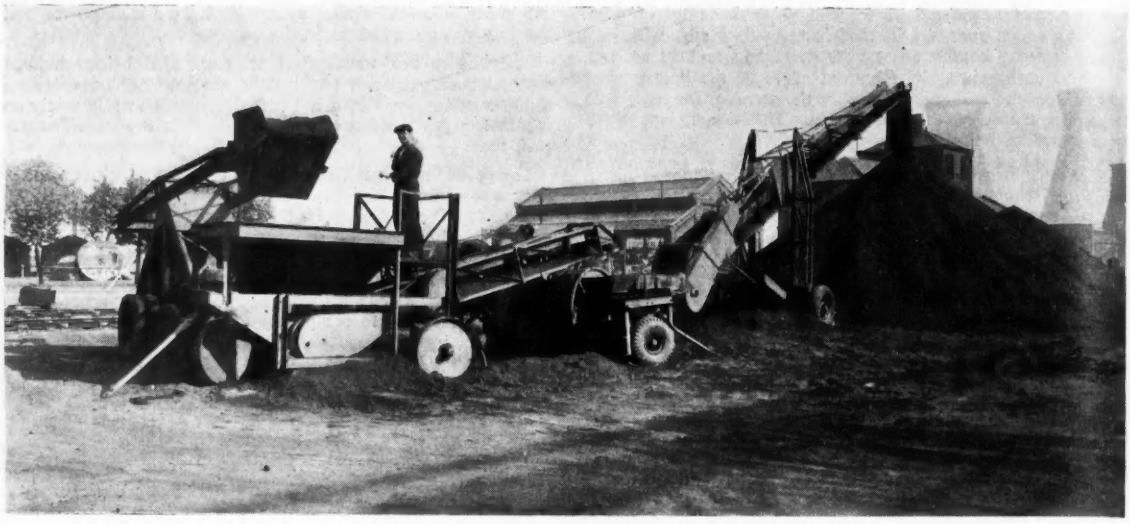


Fig. 4

to avoid sparking risks when emptying boxes. These have proved of assistance when caking has occurred in the oxide.

Before 1948 preparation of the oxide for revivification was carried out mainly by the Coleman breaker. During the war, due to labour shortages, experiments were carried out with the use of tractor-drawn plough and the rotary hoe. The latter performed well but did not stand up to the heavy conditions.

At the present time a portable cage type disintegrator is used for crushing and revivification. Two main areas are set aside for oxide storage and preparation. The fouled oxide is taken to the storage ground, and loaded by a mechanical shovel on to a feeder conveyor and thence through the disintegrator. The disintegrator discharges direct on to a portable stacker and this discharges the oxide into a conical heap. The stacker is used to overcome the dust and flying fragments which are usually associated with this type of machine.

Two labourers and a mechanical shovel driver operate this plant and handle a charge of 235 cu. yd. in 4-5 hours. The cost of this method of preparation is 8.08d. per cu. yd., which includes labour and the hire of the mechanical shovel, fuel and oil.

The arrangement of the plant is indicated in Fig. 4.

Handling of Materials

The difficulty of obtaining labour has caused modifications in methods of handling coal and coke.

Coal.—Coal is received at the works in barges loaded mainly at Beckton. The coal is brought by barge into the works dock which is 1,000 ft. long by 100 ft. wide.

On the north side of the dock are the retort houses with which are associated stocking space for 9,000 tons. On the south side of the dock is situated the main stocking area. The coal to this area is handled from barge by steam crane. The area was provided with a railway system which allowed the coal to be distributed over the area by means of steam cranes.

This method of handling coal was changed some years ago by first removing all the railway lines, except the line along the dockside. A steam crane working along this line unloads the coal from barge to form a conical shaped heap. The top part of the heap is then pushed back by bulldozer leaving a thickness of approximately 2 ft. alongside the rail and running up to a maximum of 12 ft. A fresh heap is then formed by the crane unloading further coal from the barge, and this is again pushed into a sloping heap. The process is repeated until a heap is formed to the maximum height.

When reclaiming coal the same two machines are used ; the bulldozer pushing the coal across the heap to the steam crane. A special chute is now being designed to load barges by bulldozers directly from stock.

This method of handling coal has increased the storage capacity as a larger area of the ground is available for storage.

Under test a D.4 type bulldozer handled 62.7 tons/hour to an extreme distance of 40 ft., and 44.4 tons/hour to an extreme distance of 120 ft.

The cost per ton of coal handled varies from 4.4d. to 7.6d.

Coke.—It was the practice before 1945 to store coke by means of tipping railway wagons run on heaps. This was a satisfactory method for handling large quantities of coke, but required a gang of approximately 12 men to deal with the rail track alterations. As labour was not available it was decided to attempt to store coke by means of tipping lorries. A preliminary ramp was first built of breeze and the lorries tipped over the end of this heap. The heap was thus steadily increased in height. To enable the lorries to run on the coke surface, perforated steel strip was laid down.

Two lorries are usually employed on running coke to stock in this manner. One man is employed at the hoppers for loading the lorries and three at the heap to maintain the road and assist tipping.

The approximate cost of storing coke in this manner, including hire of vehicles, is 1s. 4d. per ton.

Vertical Retort House

To meet the increased demand for gas at the end of the war, it was decided to extend the carbonising plant at Bromley by the addition of a vertical retort house of 7½ mill. cu.ft. per day capacity with provision for the addition of a further similar unit. There is sufficient ground area to build the retort houses and all the ancillary plant without encroaching on existing plant.

The new plant is designed to act as a base load plant and the carbonising section is divided into three benches, to enable repairs or setting to be carried out in manageable units. It is considered that a 2½ mill. cu.ft. per day bench consisting of five settings of eight retorts is the most suitable layout for our particular set of conditions.

From the outlet of the condenser the gas passes to the exhausters which are driven by steam turbines exhausting into a low pressure steam line. Steam driven auxiliaries also are arranged to exhaust into the low pressure steam main for use as process steam. The gas after the exhauster is to be treated in electrical detarrers, static ammonia and naphthalene washers and oxide purifiers.

Crushed coal for the new plant is being transported to the retort house by belt conveyors from the conveyor belt junction tower of Nos. 1 and 2 retort houses.

Coke from the three benches is delivered to a buffer hopper of 25 ton capacity by a system of belt conveyors which allows two benches to discharge coke simultaneously. From the buffer hopper two belt feeders serve two sets of grading screens which are entirely separate units.

Each grading system comprises one single deck scalping screen to remove over 2 in., and one double deck screen to remove the grades over 1¼ in. and also over ⅝ in., with associated shuttle conveyors. Graded coke is passed by belt conveyors to the bunkers and breeze is dropped through the final screen, into the bunker below.

Provision is made for the eventual installation of a cutting and cleaning plant.

Under the bunkers bulk loading facilities are provided for delivering coke to railway or road wagons. Sack loading points also are provided and each loading spout is equipped with a debreezing screen. The breeze separated at the loading points is collected on to a conveyor for delivery to a storage bunker.

A travelling feeder is arranged to draw off any grade of coke from the bunkers at the rate of 100 tons per hour to feed either the producers in the retort house or the stocking plant. The storage of coke other than in the main bunkers is carried out by delivering coke to a shuttle conveyor mounted on an elevated reinforced concrete gantry. By travelling the shuttle conveyor the various grades of coke can be stored in heaps.

DISCUSSION

The **Chairman** (Lieut.-Colonel J. A. Gould) congratulated Mr. Moys on an exceptionally interesting paper and remarked that as a distribution engineer he was particularly interested in the use which the author had made of bulldozers in storing and reclaiming coal. He congratulated him on having no hesitation in quoting costs, which were of vital concern to gas engineers.

Dr. **J. Burns** (Chief Engineer, North Thames Gas Board) recalled that he had his first permanent appointment on the Chief Engineer's staff of the old Gas Light and Coke Company at the Bromley works, where one learnt gas engineering the hard way. One of the old company's 'problem' works, Bromley was started by the Imperial Gas Company in 1870 in opposition to Beckton, but probably those associated with the Imperial were not quite so far-sighted as those responsible for Beckton. They put the Bromley works on the river Lea, whereas Beckton was on the Thames. Beckton could be supplied with coal from sea-going ships in 4,000 ton cargoes, but the coal for Bromley had to be transhipped on the Thames and brought up the Lea in 250 ton barges. It had always been difficult for people responsible for development to make up their minds about Bromley and therefore its development had been slower than that of the stations on the Thames, like Beckton, Fulham, and Nine Elms. Although progress had not been so rapid, Bromley had seen some very sound development in the past 10 years. The recirculation system had been developed there. He had no doubt that that had been a very sensible development, but he suggested that they should not get their views out of proportion about recirculation. The main thing was that they could operate at lower temperatures and could therefore expect to get a longer life from their refractories. In so far as it was possible to measure fuel usage in horizontal retorts he would say that there was no difference between retorts using the recirculating system and those not using it, but the life of the refractories was much better.

There had been other developments at Bromley in regard to ancillary plant. The wet purification plant had lagged behind, but with the new system of washer-coolers now being installed they would have a very good wet purification system. Members must have been impressed by an illustration the author had shown of the large ferro-concrete building for dry purification. When it was designed two or three years ago it was the most economic form of dry purification known—he used the word economic in its widest sense and with particular reference to the site conditions at Bromley at the time. Those conditions varied from time to time and he was not sure that if they were putting in a dry purification system today they would use that type. In the present dry purification system they were committed to high capital costs. He had reason to believe that before too long they would have something better to show the members.

The Bromley works stood on a site of 167 acres, and in the old days people let themselves spread, rather overlooking the fact that they had to handle materials from one building to another. Sometimes it was an advantage to confine the buildings to a small ground area. However, because of the huge site, the people at Bromley had been the originators of various means of material handling. They had developed various form of bulldozers and were now using some of the latest material handling equipment available.

Combustion Chamber Temperature

Mr. **C. Stott** (Deputy Chief Engineer, South Eastern Gas Board) said the author had described the development of a system of recirculation of flue gas to the combustion chamber and the first essential was to examine the conditions which made such a device necessary. The inherent difficulty lay in the substantial difference in heat potential at the opposite ends of the major axis of a horizontal retort. This difference was a maximum in the case of bottom retorts where with a chamber temperature of 1,360°C. a comparable flue temperature might not exceed 960°C. The key factor was undoubtedly the combustion chamber temperature, and involved in the problem were the thickness of the retort wall, the quality of the retort material with respect to its inherent refractoriness and its resistance to the slagging action of the dust carried forward from producers, the retort size with special reference to the dimension of the major axis, the closeness of temperature control in order to take the maximum advantage of the working temperature limit, and finally the period of carbonisation. In the Metropolitan Division a combustion chamber temperature of 1,360°C. was employed and all readings lay substantially within an overall range of 20°C., temperatures of 1,380°C. were reduced and 1,340°C. increased.

In the retort installations in the Metropolitan Division the interplay of the factors had been closely studied for many years, and the soundness of the conclusions reached was reflected in the standard of performance attained. A retort wall of 3 in. thickness was considered to be the best compromise between adequate strength and heat transfer. Associated with this latter factor, experience had shown that a retort major axis exceeding 21 in. could not be tolerated. With a chamber temperature of 1,360°C. heat transfer at a rate adequate for a 10 hour carbonising period was obtained, but if the major axis or any related dimension was increased, the additional heat requirement could only be met by an increased transfer from the flue side and the necessity for the increased flue temperature was the fundamental reason for recirculation. This statement did not prejudice the fact that the enhanced heat carrying capacity of the chamber gases produced by recirculation, enabled a reduction in chamber temperature to be made with a potential advantage in respect of retort life.

Refractory Quality

Having reviewed the factors of retort dimensions and temperature control, the question of the influence of refractory quality on retort life could be considered, and the following statements referred to benches of 150 retorts in 15 settings, the oval retorts being 20 ft. in length, 21 in. major axis, 15 in. minor axis. The retorts originally installed were extruded siliceous fireclay retorts, the silica content reaching 78%. All subsequent repair work was carried out using radial tile segments of rather higher silica content (80% average). Such progressive replacement of moulded retorts *in situ* by radial tiles involved cutting out the defective sections of original extruded material with some consequential damage to sound material in the process. This was one reason for their adoption of segmental retorts as from 1943.

The performances given in the table showed considerable variations and were affected by the efficiencies of the varied design of the dust boxes provided at the producer outlets and by the difficulties experienced during the war years in recruiting suitable retort house labour. It was clear that with chamber temperatures of 1,360°C. obtained by the combustion of producer gas containing dust of low fusion point, 78% silica material was subject to pronounced erosion and the items of maintenance as given were in the main necessary to make good that deterioration. An improved retort material was therefore considered and in order also to simplify repair work, the segmental retort of clay bonded silica (93% silica)

was adopted. A retort bench of 10 standard settings with segmental retorts in this material was put to work in 1943. Improved arrangements for settlement of dust from the producer gas were incorporated. The bench was let down for producer repairs in 1949, having worked for 1,800 days. The retort segments were in good condition throughout, the fused deposit normally found on the chamber side of the retort surface with 78% silica material, was negligible, and no repairs were necessary.

nor adjusted and chamber temperatures were difficult to control. It was, however, possible to carbonise to the normal standards with combustion chamber temperatures reduced by 60° C. to 1,300° C. This was in reasonable agreement with the Bromley temperature of 1,330° C. for a 14½ cwt. charge. The main flue temperatures, however, were correspondingly increased and it was found that the dust deposits in the main flues were liable to sinter, thus causing a progressive restriction in the flue section with a gradual deterioration in combustion

Replacement of Radial Tile Segments — Horizontal Retorts

Bench	Number of retorts	Repair record		Working days	Radial tile segments				Equivalent number of original segments retained
					Replacement	Flue side	Chamber side	Total	
A	150	Rebuilt :	1932						
		Repairs :	1936	1,270	First	3,670	4,481	8,151	1,449
			1939	2,234	Second	933	2,158	3,091	
			1941	2,718	Third	273	645	918	
			1945	4,000	Fourth	39	114	153	
			1948	4,826	Fifth	—	2	2	
		Jan. 24,	1950	5,253	Total	4,915	7,400	12,315	
B	150	Built :	1933						
		Repairs :	1937	1,219	First	1,699	3,186	4,885	4,715
			1940	2,149	Second	135	523	658	
			1944	3,370	Third	17	54	71	
			1948	4,707	Fourth	—	2	2	
			1949	4,863	Total	1,851	3,765	5,616	
		Jan. 24,	1950	4,927					
C	150	Built :	1934						
		Repairs :	1939	1,591	First	1,844	4,267	6,111	3,489
			1942	2,441	Second	230	1,838	2,068	
			1944	3,088	Third	18	248	266	
			1945	3,223	Fourth	—	12	12	
			1947	3,881	Total	2,092	6,365	8,457	
			1949	4,427					
		Jan. 24,	1950						
D	150	Reset :	1942						
		Repairs :	1946	1,094	Nil	—	—	—	9,600
		Jan. 24,	19 0	2,209	—	—	—		

The standard of performance in either material was high, the retorts carried a charge of 13½ cwt. and the therm yield exceeded 72 therms per ton. With a carbonising period of 10 hours, the output per retort day was 115 therms. It was of some significance to compare these results with those obtained at Bromley where recirculation was employed. The retorts in the comparison varied in length and sectional area. The carbonising period of 10 hours, however, was common, and a convenient basis for comparison was to be found in the weight of coal charged per cu. ft. of retort capacity. This figure was 44 lb. for the 21 in. by 15 in. retorts of the Metropolitan Division and 32 lb. and 36 lb. respectively for the 22 in. by 15 in. and 22 in. by 16 in. Bromley retorts. These figures provided a strong indication that recirculation was only partially achieving its full purpose.

The conclusion to be drawn was that if a retort of the correct dimension and material was used and the charging arrangements were such as to take the maximum advantage of retort capacity, then the rate of heat transference necessary for a 10 hour carbonising period, with a high standard of yield and throughput, could be obtained by standard heating methods, without incurring undue maintenance charges. In these circumstances the principle of recirculation is difficult to justify. The principle of recirculation had been investigated and prolonged trials made on existing settings. The flue gases were re-admitted to the combustion chamber through ports provided below the bottom retorts. It was appreciated that this method involved no change in burner design and was, therefore, a temporary expedient. In the light of experience, the modification in burner design which Mr. Moys found to be necessary could be well understood. It was also likely that the recirculation principle was capable of affording a more favourable heat balance when employed on recuperative settings. In their standard settings, the products of combustion from 16 burners were withdrawn down 28 vertical side flues, thence through four offtake flues to the main flue. It was soon evident that the recirculation effect was produced by very small pressure differences and it was not possible to establish uniform pressure conditions in the 28 side flues at the inlets to the recirculation ports, with a consequent pronounced variation in the extent and manner of recirculation. In fact, the end ports towards the setting fronts showed a strong tendency to by-pass combustion chamber gases directly to the flue. Recirculation doubtless took place towards the interior of the setting, but its extent could neither be measured chamber control. The procedure was abandoned, as it was felt that having regard to existing retort size and the advantages of segmental silica retorts, the performance both from the process and maintenance points of view could not be reasonably improved upon and that the recirculation system could not offset the associated problem of modification of setting design.

Recirculation of Waste Cases

Mr. **G. Dougill** (North Thames Gas Board) said he could confirm from careful measurements that the fuel consumption on horizontal retorts with and without recirculation was practically the same. The found that with recirculation they could get the same work for 1,320° C. as they got previously with a temperature of 1,370° C.. On the other hand, he did not believe that recirculation was caused mainly by injector action. They had a number of retort houses running on recirculation in which no special injector action was arranged for. To his mind the real point was to make recirculation pay a dividend, and Mr. Moys had pointed out only one way in which that could be done. If they operated at 1,320° C. it would appear to be foolish to use a refractory material like silica; it might be well to obtain a tougher and stronger material not so refractory to stand up to the work, although so far as he was concerned he must admit that he was still looking for it. What they hoped to do when circumstances allowed was to work at temperatures of 1,370° C. and increase the throughput of the retorts, for that was the most profitable way of taking advantage of recirculation. Recirculation of waste gases was no new thing, as would be borne out by anyone who had had experience in pulling down old settings.

Mr. **R. M. Farror** (South Eastern Gas Board, Wandsworth) said he had read with particular interest that part of the paper which described the evolution of recirculating settings at Bromley and he congratulated the author on the success with which that type of plant appeared to have been developed. As far back as 1934 they at Wandsworth had an opportunity of discussing with the engineers at Bromley their suggestions regarding recirculation, and following those discussions their first recirculator bed was built and put into operation the following year. During the last 15 years beds in six different works had been constructed and operated as recirculator settings, and while they had been operated over a considerable number of years the degree of success obtained had been varied. In certain cases the settings had been difficult to con-

trol, due to uneven heating throughout the length of the combustion chamber. In another instance the chimney pull which had been quite adequate with the normal type of setting was found to be inadequate for the operation of recirculator settings, necessitating the enlargement of the opening into the main flue. In a further instance, after some five years' operation, it was convenient to increase the weight of charge in the retorts and the consequent need for additional producer gas forced the heating gas from the combustion chambers direct into the recuperators and caused the partial collapse of the brickwork supporting the bottom retorts.

From their experience they considered that recirculation of waste gas could be well worth while provided that one was in a position to control the quantity of gas recycled. It appeared that the design and operation of a successful recirculator setting was a matter of trial and error. He noted that the silica segmental retorts installed in 1939 had an average working life of 3,064 working days and it was interesting to compare that with the working life of 3,025 days obtained on the first silica segmental settings constructed at Wandsworth in 1937. The latter were not recirculator settings and although picked up and shut down a considerable number of times during their working life and operated at a temperature of 1,400° C., they had no silica blocks replaced throughout their life and only required to be rebuilt on account of the poor condition of the ironwork which had been in use since 1916. It would appear doubtful whether recirculation was necessary for the promotion of long life, nor from their experience had it appeared that combustion temperatures in the region of 1,400° C. were detrimental to the life of a properly constructed silica retort.

He asked whether the author had been able to establish if there was any difference in fuel consumption when operating normal as compared with recirculator settings; whether any difficulties arose by reason of installing recuperators in such a manner that producers of adequate size could be installed; if there was any particular reason for the waste gas not being taken direct from under the bottom retort instead of being led back from the recuperators; and if the author had come to any conclusion regarding the relative advantage of using the two types of silica, *i.e.*, Derbyshire silica firebrick, presumably clay-bonded, and that supplied by Gibbons Brothers, which presumably was lime-bonded.

Scrubber Standpipes

He noted that the average quantity of coke and breeze made for sale over a period of six years was 12.94 cwt. per ton of coal carbonised; it would be interesting to know the basis on which those figures were computed, particularly the coal and coke ratio for the type of coal used. In view of the difficulty the author had experienced in fitting ascension pipes to both ends of the retorts it would be interesting to know if scrubber standpipes were considered. The weight of the charge of 14.5 cwt. stated for retorts 22 in. by 16 in. by 21 ft. long was light for that size of retort; was the small weight of charge due to the wish of the engineering staff or to the limitations of the charging machine used?

Regarding producer gas manufacture he noted that a wood packed washer was used to treat producer gas. He wondered if the author considered the washer essential. When it was decided to install diluent gas producers at all the works of the Wandsworth undertaking there was considerable discussion as to whether washers of that type should be installed. It was finally decided to install the plant without washers and from experience gained it would seem doubtful whether that piece of plant was necessary. It was noted that direct contact washer-coolers were being installed in lieu of the more popular water tube and he asked whether the author could give the comparative capital and operating costs for the two types of plant when designed to give the same performance. He also enquired whether difficulty was found in separating the tar, naphthalene, and water in the direct contact type of plant.

He understood that the purifier boxes were provided with both mechanical valves and water-sealed 'U' connections. At Wandsworth the tower purifier installations had only been provided with water-sealed valves without the additional cover of dry valves, and hitherto this had proved a satisfactory arrangement. The method of stacking coke with a lorry driving over metal strips on the coke heap was interesting, but it would appear that it could not well be applied to any but a very large site. Provision was made for the storage of graded coke, but they had not been told of the extent to which degradation of the coke had taken place, particularly in regard to the size of the broken and nut coke rather than the formation of breeze which could be removed by the reclamation of the coke by means of the Harman loader and passing it over a mobile debreezing screen.

Mr. **W. A. Evetts** (Watford Divisional Engineer, Eastern Gas Board) questioned whether the upward and downward flow arrangement in the purifiers ensured an ever distribution of the gas.

Mr. **J. D. C. Woodall** (Maidstone Group Manager, South Eastern Gas Board) said that horizontal retort installations during recent years at Maidstone had been influenced by the work of the various engineers at Bromley. The designers of their settings had attempted to do one of the things which Mr. Dougill had suggested, namely, to use recirculation to obtain a larger throughput from the setting. Their horizontal settings were among the largest in the country; each had ten 24 in. by 18 in. retorts 24 ft. through, and they were regularly carbonising charges of 22 cwt. The house was put to work in two sections, the first, of five beds, three years ago, and it was essential to run them in two shifts only so they burned off their charges in 12 hours. Early in the history of the installation they had to carbonise some Kent coal and they had difficulty in getting it to burn off in 12 hours. With the setting working absolutely flat out they could not get the temperature in the combustion chamber up to over 1,300° C., and there was no doubt they were getting recirculation in the reverse direction. The temperature of the waste gases was very high and the top of the regenerator tubes was very hot. After 18 months they let one setting down and took the opportunity of carrying out some experiments. Originally the recirculator ports were similar to those described in the paper, measuring 9 in. by 6 in. They reduced them by half to 9 in. by 3 in., and it was clear when the bed was put to work again that they had far better control. The construction of the remaining beds had not advanced to such a stage as to prevent them introducing modifications, and they cut down the recirculator ports still further to 9 in. by 2 in.—a total of 18 sq. in. compared with the original 54 sq. in. This reduction made a great difference and they had no difficulty whatever in controlling the temperature in the new beds.

They were running comfortably on temperatures of 1,330°-1,340° C. and burning off their charges in 12 hours without difficulty, with a total daily throughout of 22 tons per bed. With regard to the design of the new purifiers at Bromley, he recalled that he had read a paper some time ago in which he advocated the use of ground-level boxes because of their cheaper capital cost. He was horrified to see the design of the Bromley installation. He asked whether there was a heater on the inlet to each box; if not, he suggested that they might meet with some trouble with their long external mains.

Mr. **C. A. Deas** (Works Engineer, Tottenham, Eastern Gas Board) asked if Mr. Moys really thought the upper floor for the purifiers was necessary; surely it was better to take the oxide straight into the boxes. He suggested it was a sheer waste of money to have the upper floor. The only excuse for such a design was congestion and the lack of anywhere else to put the oxide.

The Author's Reply

Mr. **Moys,** replying to the discussion, said the figures given by Mr. Stott were extremely interesting. On the question of retort repairs, figures he had got out certainly showed that one could rebuild a retort in situ rather more cheaply than resetting at the present time. The operation of a setting for 5,000 days, and then replacing only a few tiles, was extremely good. They had found that the injector action of the nostril did not have any bearing on the recirculation, and that was why they had got away completely from the injector burner. They had settled down to a round figure of about 50 sq. in. for the recirculation ports. The size of the port opening was a matter which had to be decided for each particular design of setting. Their fuel consumption did not show any sign of increase. They had found in a survey that the temperature at the inlet of the regenerator flue was approximately 1,000° C. with 1,330° C. on the combustion chamber side.

On the question of comparison between Derbyshire and straight silica, the Derbyshire material was softer and the action of the pusher on the bottom of the setting resulted in more wear when Derbyshire silica was used than when ordinary silica was employed. They ran a series of fuel tests in the early days and they were unable to find any difference between the straight retort houses and those in which recirculation was practised. They had seriously considered scrubber standpipes but they were almost up against the narrow settings. A question had been raised as to whether the washer was essential for the producer gas. Their first reason was to remove dust

(*Continued at foot of p.* 410.)

THERMAL RATING OF BURNER INJECTORS*

By C. WHITEHEAD,
Middlesbrough Division, Northern Gas Board.

***EDITOR'S NOTE*:—This short paper was awarded the President's Prize given by Mr. W. O. Kirkwood, of Sunderland, first President of the Northern Junior Gas Association, 1948-49.**

THE number of different types of burner injector is considerable, so for the purpose of this paper it is proposed to discuss the rating of injectors fitted to the standard domestic gas cooker.

The recommendation of the British Standards Institution for post-war cookers is given in B.S. 1250, Part 2, 1946, as follows: 'The cooker will incorporate a gas pressure governor to give 2½ in. water gauge, and the burners will be provided with fixed injectors having orifice sizes suited to the quality of the gas on which the appliance will be used.' This recommendation is excellent provided gas characteristics are controlled within very narrow limits to give constant values. Once the gas manufacturers are able to supply gas with constant characteristics then the burner designers can produce a burner to give excellent results.

The important disadvantage of fitting fixed injectors is the fact that hardly any two gasworks supply gas with identical characteristics. For example, in the Middlesbrough Division gas is supplied with the following declared calorific values—400, 460, and 500 B.Th.U./cu.ft., and works supplying gas of the same calorific value do not produce a gas of the same specific gravity due to different methods of carbonisation.

From the above it is obvious that the appliance manufacturers cannot possibly supply burner injectors designed specifically for each gasworks, since the fitting of special burners is only economical when a large number of appliances are being sold in one district.

To overcome this difficulty the appliance manufacturers supply cookers equipped with constant pressure governors and fixed orifice injectors, the size of the injectors being in accordance with calorific value groups. A typical example of this method of grouping is as follows:—

Group 'A'—Declared calorific value—375-425 B.Th.U./cu.ft.
" 'B'— " " " —425-475 " "
" 'C'— " " " —475-525 " "
" 'D'— " " " —525 upwards.

According to this method of classification cookers used in the Middlesbrough area of supply should be fitted with Group 'C' injectors. A cooker fitted with Group 'C' orifice injectors was tested in the Middlesbrough appliance laboratory and it was found that all the construction on the burners were above those specified by the manufacturers.

This over-rating of the burners was considered to be due to the fact that the injectors were designed for a gas of higher specific gravity than that supplied in Middlesbrough.

It was suggested that Group 'D' injectors might correct this fault since the orifices are smaller in diameter than the corresponding orifices of the Group 'C' injectors.

The results of the tests are given below:—

Test No. 1.

Data:
The gas was coke oven gas.
Specific gravity, 0.41.
Calorific value, 500 B.Th.U./cu.ft.
Burner pressure, 2.5 in. w.g.

Injector group	Burner No.	Orifice size morse	Consumption S.G. 0.41 cu.ft./hr. S.T.P.	Rating C.V. 500 B.Th.U./hr.	Specified rating B.Th.U./hr.	Calculated sp. gr. to give spec. rating
C	1	39	28.0	14,000	12,000	0.56
	2	47	17.6	8,800	8,000	0.50
	3	43	20.7	10,350	10,000	0.44
	4	34	33.8	16,900	14,000	0.60
D	1	44	19.4	9.700	12,000	0.27
	2	50	14.5	7,250	8,000	0.34
	3	47	17.7	8,850	10,000	0.32
	4	38	29.7	14,850	14,000	0.46

Test No. 1 shows that with a gas of calorific value 500 B.Th.U./cu.ft. and specific gravity, 0.41 burners fitted with Group 'C' injectors will be over-rated and burners fitted with Group 'D' injectors will be under-rated.

A further test was carried out with gas of calorific value 500 B.Th.U./cu.ft. and specific gravity 0.48; details of this test are given below:—

Test No. 2.

Data:
The gas was a mixture of carburetted water gas and coke oven gas.
Specific gravity, 0.48.
Calorific value, 500 B.Th.U./cu.ft.

Injector group	Burner No.	Orifice size morse	Consumption S.G. 0.48 cu.ft./hr. S.T.P.	Rating C.V. 500 B.Th.U./hr.	Specified rating B.Th.U./hr.
C	1	39	25.6	12,800	12,000
	2	47	16.4	8,200	8,000
	3	43	19.3	9,650	10,000
	4	34	31.4	15,700	14,000

Test No. 2 shows that Group 'C' injectors give satisfactory burner ratings when the specific gravity of the gas is approximately 0.50.

Consideration of the above tests shows that a classification of gases upon a calorific value basis for the purpose of burner rating is useless unless the specific gravity of the gas is taken into account.

The Wobbe Index

The gas rate to an appliance through a fixed orifice varies inversely as the specific gravity of the gas thus the thermal input will also vary inversely as the specific gravity. The thermal input varies directly as the calorific value of the gas. From these two points it is obvious that a measure of the rate of heat input is the Wobbe index, which is:—

$$\frac{\text{Calorific value}}{\sqrt{\text{Specific gravity}}}.$$

* Paper to the Northern Junior Gas Association, December 9, 1949.

PLANT IMPROVEMENTS (*Continued from p. 409*)

and to provide a measure of cooling for the gas before mixing with the water gas. They had not run their producers very much—only about 28 days per year—and there was no evidence of any large amount of dust being carried forward.

They had had no difficulty with regard to the separation of tar and liquor. Roughly 11 gal. of liquor per ton of coal carbonised was drawn away from the washer-cooler, and something like 1½ gal. of tar was separated. The liquor was reasonably strong, about 14 oz. In reply to Mr. Evetts, their experience with the split flow in their purifiers was very satisfactory. They had two heaters to each stream but they did not have a heater to each box; he admitted it might pay to do so. He welcomed Mr. Woodall's statement as to the success of his experiments with the size of the ports. His reply to Mr. Deas was that they felt the upper floor for the purifiers was justified in view of the present cost of plant, which was something like three times the 1938 level. One effect of the arrangement was that they were able to spread their labour load. Purifier work was not in any case a very attractive job, and in practice it had been found that the men were more interested in their work as a result of the arrangement whereby they spent part of their time placing the oxide on the upper floor.

A vote of thanks was accorded to the author on the proposition of Mr. S. W. Hammond (Eastbourne), seconded by Mr. S. C. Herbert (Kent Suburban Division, South Eastern Gas Board).

It is not suggested that the Wobbe index is a measure of combustion characteristics, but that it is the most important factor affecting the thermal input to a burner. Gases of different calorific value and different specific gravities can give the same B.Th.U. rating when burned at a burner, providing their Wobbe indices are equal.

From tests Nos. 1 and 2 it is apparent that the Group 'C' orifices are designed for a gas of calorific value 500 B.Th.U./cu.ft. and specific gravity of 0.50. This gas would have a Wobbe index of 707.1.

The table below shows the relationship between calorific values and specific gravity to give a Wobbe index of 707.1.

Table Showing Relationship Between Calorific value and Specific Gravity to Give a Wobbe Index of 707·1.

Calorific value B.Th.U./cu.ft.	Specific gravity
500	0.500
490	0.480
480	0.461
470	0.442
460	0.423
450	0.405
440	0.387
430	0.370
420	0.353
410	0.336
400	0.320

As a result of these calculations a test was carried out on a supply of gas with a Wobbe index of approximately 707.1 with the following results:—

Test No. 3.

Data:
Calorific value, 472 B.Th.U./cu.ft.
Specific gravity, 0.46.
Wobbe index, 695.8.

Injector group	Burner No.	Orifice size morse	Consumption S.G. 0.46 cu.ft./hr. S.T.P.	Rating C.V. 696 B.Th.U./hr.	Specified rating B.Th.U./hr.
C	1	39	24.4	11,530	12,000
	2	47	16.1	7,600	8,000
	3	43	20.7	9,780	10,000
	4	34	29.0	13,700	14,000

From this test it is obvious that Group 'C' orifices should be fitted to the cookers, yet the makers recommend Group 'B' injectors. Cookers fitted with Group 'B' injectors when tested on this gas supply showed over-rating of all burners.

The above evidence suggests that the Wobbe index would be a suitable factor for the classification of different gases in order to ensure the correct thermal rating of burners fitted with fixed orifice injectors.

Combustion Characteristics

Although the Wobbe index is an ideal factor with regard to thermal rating it does not give any indication of the thermal characteristics of the gas.

Two gases of the same Wobbe index can be burned at a burner, but although they will give the same thermal input they will not necessarily give the same type of flame.

Several types of test burners have been developed to indicate the effect of changes in the combustion characteristics of a gas upon the behaviour of atmospheric gas burners. The most popular of these burners has been the Aeration Test Burner (A.T.B.) but, as yet, no satisfactory method has been introduced to measure the combustion characteristics of a gas.

From the above, it is obvious that until such a time as a method for measuring the combustion characteristics is found there is no satisfactory method of classifying gases for the purpose of designing fixed orifice injectors for appliances.

It is the author's suggestion, therefore, that appliances are more versatile if fitted with variable injectors and also if methods to control the amount of primary air to the burners are adopted.

DISCUSSION

Mr. **P. N. Lee** (Middlesbrough) remarked that the theme seemed to centre on a complaint that the manufacturing side did not control the specific gravity within close limits. With present-day shortage of plant, peak loads had to be met by the manufacture of water gas with a consequent raising of specific gravity. A further suggestion was that control of the Wobbe index should be effected by alteration in the calorific value of the gas. Taking as an example a gas having a specific gravity of 0.58, which had on occasion been sent out at Middlesbrough, then, on the figures given, an increase in calorific value to 537 B.Th.U. would be required. It was impossible for a works such as Middlesbrough, with a constant supply of coal gas which could not be exceeded, to meet peak demands without a high admixture of water gas and a resulting high specific gravity.

Mr. **Whitehead** appreciated Mr. Lee's remarks, but suggested that Middlesbrough's gas varied in specific gravity to an abnormal degree. Middlesbrough was particularly badly placed as regards the control of gas characteristics, since coke oven gas was bought in bulk and peak loads were met by increasing the quantity of carburetted water gas.

Mr. **S. Jones** (Middlesbrough) said that with atmospheric gas burners the amount of air entrained remained the same with changes in the specific gravity if the pressure remained constant. With modern cookers fitted with fixed injectors and governors it followed that since the pressure was constant the volume of air entrained to each burner would remain constant, so that if the injectors were designed on the basis of the Wobbe index as suggested by Mr. Whitehead, they would at least obtain a constant proportion between the air entrained and the combustible constituents of the gas, providing the Wobbe index remained constant. Unfortunately, however, while all gas-works maintained a constant calorific value the specific gravity varied, and it was not the practice to increase the calorific value if the specific gravity increased, due, say, to the addition of carburetted water gas; consequently the Wobbe index was subject to variation. Again, the maintenance of a constant size of inner cone did not depend entirely on the pressure, C.V., and specific gravity. These might be the same for gases which differed in their constituents, and varying constituents had varying flame speeds which would in themselves vary the size of the inner cone.

Reasonably Constant Conditions

Fortunately for the gas industry the constituents of coal gas, and consequently the calorific value and specific gravity remained reasonably constant, so that normally they did not experience any large variation in the flame formation on domestic appliances. He was inclined to agree with Mr. Whitehead that the design of fixed injectors would be better based on the Wobbe index than on C.V. with a fixed specific gravity; two variable factors would then be covered instead of one. The use of neat flame appliances was rapidly developing, and these eliminated the difficulties experienced with variation in the qualities enumerated. The use of neat flames on cookers had been developed to a limited extent, and even though he had no personal experience of this type of cooker, it would appear that the correct lines were being followed. Present economic conditions were such that it was not always profitable to install new carbonising plant, and there was a growing tendency to make use of water gas, which inevitably caused substantial variations in the specific gravity. In these circumstances, the necessity to develop the use of neat flame gas appliances would appear highly desirable.

Mr. **W. E. Whitney** (Stockton) said he would be interested to have Mr. Whitehead's views on the recommendations concerning gas quality put forward in the Heyworth report. Also, if he considered that the limits of variation specified for calorific value and specific gravity of plus/minus 3% and plus/minus 5% respectively would enable manufacturers to generally adopt fixed orifice injectors on gas appliances.

Satisfactory Limits

Mr. **Whitehead** replied that if the limits of variation of calorific value and specified gravity recommended in the Heyworth report were adopted, then manufacturers could supply appliances fitted with fixed orifice injectors provided these injectors were designed for use in the particular gas being considered. When the Heyworth report recommendations were referred to the Wobbe index, a limit of $\pm 5\frac{1}{2}\%$ was obtained, *i.e.*, a limit in thermal input of ± 550 B.Th.U./hr. on a 10,000 B.Th.U./hr. burner. These limits were satisfactory provided the manufacturers supplied burners grouped on Wobbe index and not on a calorific value basis.

Mr. **S. N. P. Nelson** (West Hartlepool) suggested that the author was putting up a case for variable injectors and adjustable primary air as against fixed injectors chiefly because of the constantly varying combustion characteristics of the gas as sent out by their various works. Also, having constantly to send on to the district maintenance staff to re-adjust these